DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
8945 LATTY AVENUE
BERKELY, MISSOURI 63134

January 20, 2005

REPLY TO
ATTENTION OF:

Formerly Utilized Sites Remedial Action Program

Subject: Final Version of North St. Louis County Haul Road Analysis and Justification for Additional Investigation – Evaluation of Inaccessible Materials Beneath Pavements dated January 7, 2005

Mr. Dan Wall
U. S. Environmental Protection Agency
Region VII, Superfund Branch
901 North Fifth Street
Kansas City, KS 66101-2907

Dear Mr. Wall:

Please find enclosed a copy of the *North St. Louis County Haul Road Analysis and Justification for Additional Investigation – Evaluation of Inaccessible Materials Beneath Pavements* Final, dated January 7, 2005 for your records. The responses to comments on the subject document were sent under separate cover on December 22, 2004.

If you need any additional information or have any questions regarding this document, please contact me at (314) 260-3915.

Sincerely,

Sharon R. Cotner
FUSRAP Program Manager

Enclosures
CF: Mr. Robert Geller

FINAL

NORTH ST. LOUIS COUNTY HAUL ROAD ANALYSIS AND JUSTIFICATION FOR ADDITIONAL INVESTIGATION – EVALUATION OF INACCESSIBLE MATERIALS BENEATH PAVEMENTS

ST. LOUIS, MISSOURI

JANUARY 7, 2005

Prepared by
U. S. Army Corp of Engineers, St. Louis District Office,
Formerly Utilized Sites Remedial Action Program

With assistance from
Science Applications International Corporation (SAIC)
Under Contract No. DACW43-00-D-0515

TABLE OF CONTENTS

SECTION PAGE

1.0 INTRODUCTION AND PURPOSE 1

2.0 SITE BACKGROUND AND HISTORY 2

2.1 TIMELINE OF EVENTS 3

2.2 METHODS OF POSSIBLE IMPACT 7
2.2.1 How Impacts May Have Been Caused By Truck Transportation 8
2.2.2 Protection of the Materials Under Pavements From Direct Impacts 8
2.2.3 Low Probability of Occurrence Mechanisms that Could Result in Impacts Under Road Pavements 8

2.3 CONSIDERATIONS AND PROCEDURES 9

2.4 HISTORICAL FIELD-TESTING 10
2.4.1 Results Of Initial Testing Under Roads 11

2.5 HAUL ROUTES BETWEEN THE SLAPS AND THE HISS/FUTURA SITE 16
2.5.1 Evaluation of Haul Routes Between the SLAPS and the HISS 23
2.5.2 Methods for Transporting Residues Between the SLAPS and the HISS 23
2.5.3 Conclusions 25

2.6 RESEARCH SUMMARY 26

3.0 SUMMARY OF POTENTIAL IMPACTS BY ROADS 33

3.1 SUMMARY OF RESULTS OF HISTORICAL TESTING 33

3.2 TYPICAL RIGHT-OF-WAY WIDTHS 40

3.3 AREAS OF FILL 41

3.4 BRIDGES 41

3.5 ADDITIONAL INFORMATION 45

4.0 REFERENCES 46

LIST OF APPENDICES

A.1 McDonnell Boulevard A-1
Figures M1 Through M8
A.2 I-270, Including Pershall & Dunn Roads A-5
Figures P1 Through P8
A.3 Eva Avenue A-8
Figures E1 Through E2
A.4 Frost Avenue A-11
Figures F1 Through F2
A.5 Hazelwood Avenue A-16
Figures H1 Through H4
A.6 Latty Avenue A-20
Figures L1 Through L3
A.7 I-170 ..... A-25
Figures I1 Through I7
A.8 Lindbergh Boulevard A-28
Figures LB1 Through LB3
A.9 North Hanley And Graham Road A-31
Figures HA1 Through HA7
A.10 Airport Road A-35
Figures A1 Through A3
A.11 Banshee Road A-37
Figures B1 Through B3
A.12 Polson Road A-40
Figures A1 Through A3
A.13 Seeger Industrial Road A-42
Figures S1 Through S1
A.14 Pavement Evaluation Of Nyflot Avenue A-44
Figures
A.15 Selected Historical Documents A-46

REFERENCE DOCUMENTS

RD 1 Copy Of "History Of Material Storage At The St. Louis Airport Storage Site" A-47

LIST OF EXHIBITS

EXHIBIT A – Investigation Under Road Pavement
EXHIBIT B – Key Map of Figures Included in Appendices

LIST OF TABLES

SECTION		PAGE
Table 2-1	Comparison of Haul Routes Between the SLAPS and the HISS	23
Table 2-2	Aerial Photographs Available	27
Table 3-1	Possible Impacts from Haulage SLAPS and the HISS 1966/67	35
Table 3-2	Possible Impacts from Haulage HISS and West Lake Landfill 1973	36
Table 3-3	Potential Wind, Stormwater or Floodwater Impacts	37
Table 3-4	Results of Testing	38
Table 3-5	Summary of Findings	39
Table 3-6	Cause of Impacts	40

LIST OF FIGURES

SECTION		PAGE
Figure 2-1	General Location of the Mallinckrodt Chemical Plant and the SLAPS, HISS, and West Lake Landfill Storage Sites in St. Louis, Missouri	12
Figure 2-2	Diagram of Route Scanned in the Vicinity of the Mallinckrodt Chemical Plant Site, St. Louis, Missouri	13
Figure 2-3	Diagram of Routes Scanned by Oak Ridge National Laboratory and Routes Characterized by Bechtel National, Inc. in the Vicinity of the Lambert-St. Louis International Airport, St. Louis, Missouri	14
Figure 2-4	Locations of Impacts Found By Testing	15
Figure 2-5	Routes Between the SLAPS and the HISS Route A Most Direct Route	17
Figure 2-6	Routes Between the SLAPS and the HISS Route B	18
Figure 2-7	Routes Between the SLAPS and the HISS Route C	19
Figure 2-8	Route Between the SLAPS and the HISS Route D	20
Figure 2-9	Route Between the SLAPS and the HISS Route E	21
Figure 2-10	Route Between the SLAPS and the HISS Route F	22
Figure 2-11	USGS Quad Map Locations	30

LIST OF ILLUSTRATIONS

Illustration 2.1 Typical 1960 20-Ton Over-the-Road Dump Truck.....25

LIST OF ACRONYMS AND ABBREVIATIONS

AC	asphaltic concrete
AEC	Atomic Energy Commission
aka	also known as
B&K	B & K Construction Inc.
BNI	Bechtel National, Inc.
CADD	computer-aided design and drafting
CDC	Commercial Discount of Chicago
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
HISS	Hazelwood Interim Storage Site
MoDOT	Missouri Department of Transportation
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratories
OU	Operable Units
PCC	portland cement concrete
ROW	right-of-way
SAIC	Science Applications International Corporation
SLAPS	St. Louis Airport Site
SLDS	St. Louis Downtown Site
SOR	sum of ratios
USGS	United States Geological Survey

DEFINITIONS:

Impact – Subject to the potential presence of **residue**.

Impervious – Will not allow the passage of fluid or dust.

Material – Any natural soil or manmade substance beneath a **road pavement**.

Obliterated – Completely demolished and removed leaving no clear traces.

Residue – Waste byproducts from processing activities carried out at Mallinckrodt Chemical Works in downtown St. Louis.

Right-of-way – Land subject to an easement for the passage of the public and other public uses.

Road pavements – The hard, durable, **impervious,** manmade surface covering of a street designed for the passage of vehicles.

1.0 INTRODUCTION AND PURPOSE

This report determines the potential location of possibly impacted materials beneath road pavements around the St. Louis Airport Site (SLAPS) and the Hazelwood Interim Storage Site (HISS). This report is limited to evaluating materials near or underlying the roadways located within an area referred to as the SLAPS Road Study Area. The area to be studied is bounded by the following roadways (See Exhibit A):

On the West by Lindbergh Boulevard,
On the North by Interstate 270,
On the East by Graham Road and North Hanley Road,
On the South by Airport Road to its intersection with McDonnell Boulevard and with McDonnell Boulevard to its intersection with Banshee Road and then with Banshee Road

This determination was accomplished by reviewing available records of pavement histories, road construction documents, historical aerial photographs, available pavement borings, historical maps and documents, site investigations, and other miscellaneous documents to determine when and how these pavements were constructed and when and how the materials beneath these pavements may have been potentially impacted by residue hauling or other possible means of residue transportation.

Impervious pavements that existed during the period of possible impacts protected the underlying material from direct exposure to residue; therefore, there is no need to subject those materials to further investigation. Conversely, further investigation is needed in the areas where pavements were constructed over materials possibly impacted by prior exposure to residues.

This report examines the history of road pavements relative to the effects from residues in the SLAPS Road Study Area.

This report

- Identifies the changes in road surface location, type of construction, right-of-way, and pavement widths for the SLAPS Road Study Area roads from 1946 to the present (2004).
- Determines whether the road surfaces prevented residue from migrating from the surface to directly affect the material beneath that pavement.
- Identifies where pavements have been constructed over areas possibly previously impacted by residue. This residue originates from residue hauling activities or water and wind erosion from the storage of wastes in the SLAPS Road Study Area.
- Evaluates the historical evidence, in conjunction with evidence from field-testing, to determine where further investigation is warranted.

Those properties along each roadway which have been identified as vicinity properties are listed in the following table.

Table 1-1 Vicinity Properties adjoining roadways

Road Segment	Vicinity Proprieties
Eva Avenue	16, 17, 18, 19
Hazelwood Avenue	24, 31A, 32, 33, 34, 35, 35A, 37, 38, 39, 39A, 40, 41, 42, 43, 44, 45, 46, 47, 48, 48A, 53
Latty Avenue	35, 37, 38, 39, 39A
Frost Avenue	19, 20, 20A, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31
I-170	31, 31A, 33, 34, 35, 39, 39A, 50
I-270	48A, 53, 54, 55, 56, 57, 58, 63A
Lindbergh Boulevard	3, 63
North Hanley Road	52
Graham Road	15
Airport Road	15
Banshee Road	14A
Pershall and Dunn roads	48, 48A, 49, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62,
Polson Road	55, 56
Seeger Industrial Drive	21, 22, 23, 24, 32
Nyflot Road	39, 41
McDonnell Boulevard	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 14A, 15, 16

2.0 SITE BACKGROUND AND HISTORY

Starting in the early 1940s, uranium metal and other radioactive substances were produced at the Mallinckrodt Chemical Works in St. Louis, Missouri. These facilities, as well as other properties in their vicinity, are now collectively known as the St. Louis Downtown Site (SLDS). Beginning in 1946 the residue from this processing operation was transported to and stored on a 21.7-acre property that is located north of St. Louis Municipal Airport (now Lambert-St. Louis International Airport). This parcel and surrounding areas are collectively now known as the SLAPS. The site was used for the storage of residues from 1946 to 1967. The residues were transported from the SLDS to the SLAPS by truck over public roadways. In 1966 the residues were sold to a private company, the Continental Mining and Milling Company (Continental), which transported the residues from the SLAPS over the public roadways to a second site for eventual reprocessing and shipment by rail to Cotter Corporation facilities in Canon City, Colorado. This second site, 9200 Latty Avenue, is located south of Latty Avenue and east of Coldwater Creek. This property and the surrounding properties are collectively known as the Latty Avenue Site. The area was used to store residues from 1966 to 1973. The SLAPS and the Latty Avenue Site are collectively known as the North St. Louis County Sites.

After the removal of the residues from the SLAPS by Continental, the SLAPS site was transferred to the control of the St. Louis Airport Authority. The structures at the site were

demolished and buried on-site. In 1970, approximately 1 to 3 feet of fill from airport construction projects was brought to the SLAPS and spread over the site. This fill and the returning trucks traveled over public roadways.

After the removal of much of the residue from the HISS by rail transport to Colorado, a portion of the remaining residues were removed and transported over the public roads to the West Lake Landfill facility for disposal. This activity occurred in 1973.

During all of these activities, the residues were stored on the open ground with few engineering controls to prevent erosion by water or wind action. The HISS and the SLAPS are also partially within the floodplain of Coldwater Creek.

2.1 TIMELINE OF EVENTS

The residue from the Mallinckrodt refining operation is the potential source of impacts along the roads. The events listed chronologically below are relevant to determining the possible impacts to roads.

- On April 24, 1941, Mallinckrodt began processing uranium ore in downtown St. Louis. Mallinckrodt continued uranium refining in downtown St. Louis until 1959. These activities were performed under contracts with the Manhattan Engineer District and the United States Atomic Energy Commission (AEC).
- In 1945 the Manhattan Engineering District began the process of looking for a 5-acre site to store residues from the SLDS. The need for the land was urgent because there was no room to store these residues at the downtown plant. The preferred land was to be:
  - Fairly isolated or easily capable of isolation by the erection of fences
  - Not subject to floods or excessive ground drainage
  - Readily available, and preferably located to the north or northwest of the city.
- On March 2, 1946, permission was obtained to use the SLAPS for the storage of residues. Actual title was not acquired until January 3, 1947. This land was acquired by condemnation. Due to the "unfavorable publicity" generated by the condemnation proceedings, a decision was made to erect a fence around the site. Most of the wastes and residues were stored on open ground.
- From 1946 through 1958, residues were transported to the SLAPS for storage, mostly from Mallinckrodt in downtown St. Louis. Private contractors using government-supplied equipment transported the residues over the public roadways.
- In 1948 and 1949, highly radioactive radium-bearing residues were transferred from the SLAPS to Fernald, Ohio.
- In 1952, "several hundred tons of contaminated metal and debris" were buried at the SLAPS under 6 to 8 feet of fill obtained from McDonnell Aircraft.

- In 1954, sixty tons of captured Japanese uranium residues and approximately 500 tons of other "low grade uranium bearing residues" were brought to the SLAPS from Middlesex, New Jersey.
- In an inventory of the site dated April 11, 1959, it is stated that the following residues had been delivered to the SLAPS:

Pitchblende Raffinate, AM-7	74,000 tons
Raffinate, AM-10	32,500 tons
Slag, C-liner	7,800 tons
Interim Residue Plant Tailings, C-701	5,400 tons
Barium Cake, AJ-4	10,200 tons
Vitro residues	290 tons
Captured Japanese Uranium precipitates	60 tons
55,000 30- and 50-gal drums as scrap	3,500 tons
Total tons hauled to the SLAPS prior to 1960	133,750 tons

These values were based on weight of residues delivered to the site with no adjustment for moisture pickup.

Source: March 22, 1960 drawing titled MCW DWG #6-1403-19-C.

See Reference Document No. 1 for a copy of a document titled *History of Material Storage at the St. Louis Airport Storage Site,* which contains a description of the residue designations listed above and additional information concerning the origins and disposition of the residues.

- In 1959, a railroad siding and loading facilities were constructed at the SLAPS.
- In 1960, Federal Division of Raw Materials explored disposal of the residues. Per their June 1960 memo, the refined value of the cobalt, nickel, copper and selenium in the residues was believed to be $15,000,000 to $20,000,000. In addition the residues contained 250,000 pounds of uranium, the value of which was not included in the $15,000,000 to $20,000,000.
- In 1962, bids were invited on the residues, and an award was made to Contemporary Metals Corporation, Los Angeles (Contemporary); however, Contemporary failed to furnish the $50,000 performance bond and pay the $126,500 bid and defaulted on the contract. Contemporary did no work on the site.
- Two additional invitations to bid were issued in 1964, neither of which produced a responsive bid.
- In 1964, 4,000 tons of C-Oxide residues were shipped either to Fernald, Ohio for processing or to Weldon Spring for storage.
- A September 23, 1965, Memo titled St. Louis Airport Resides listed the inventory for another invitation to bid to be following five categories of residues. Separate bids were invited for each category.

Pitchblende Raffinate	74,000 tons
Colorado Raffinate	32,500 tons
Barium Cake, unbleached	1,500 tons
Barium Cake, leached	8,700 tons
Miscellaneous Material in Drums	350 tons

The memo also discussed the proposed remediation of the site as follows:

> "The major problem would appear to be in 5 acres in the west end of the area. This was originally low swampy ground, drained by a couple of ditches. It was filled and graded and then the Colorado Raffinate, some drummed material and contaminated waste of all kinds were buried on this fill. However, there is buried somewhere in the fill about six carloads of metal scrap, an unknown quantity of drums, and a jeep."

- In February 1966, Continental Mining and Milling (Continental) purchased the five residue items listed above for $126,500. Continental then borrowed $2,500,000 from Commercial Discount of Chicago (CDC) for the processing operation. The residues are believed to have totaled 117,000 tons. Continental later purchased 7,800 tons of C-Liner Slag for an additional $14,000.
- On December 21, 1965, the Village of Hazelwood approved the use of the 9200 Latty Avenue property by Continental for refining operations.
- On February 14, 1966, AEC gave Continental a Source Material License for "Removal of stockpile residues from 50 Brown Road, Robertson, Missouri, and storage only at the licensee's facilities located at 9200 Latty Avenue, Hazelwood, Missouri, in accordance with the procedures described in the licensee's application dated February 4, 1966, and supplements dated February 7 and February 8, 1966."
- On February 28, 1966, AEC gave Continental Notice to Proceed to remove the residues from the SLAPS. Continental was given 400 days, until April 4, 1967, to complete the task.
- In a five-month period, some time between March 1966 and April 1967, the residues were moved from the SLAPS to the HISS by a hauling contractor hired by Continental. This move required ten dump trucks for a period of five months and cost Continental $100,000.
- On February 3, 1967, CDC foreclosed on Continental's loan. CDC became the owner of the residues and the HISS property at a public sale.
- February 14, 1967, the AEC provided a "punch list" of items in need of completion at the SLAPS before April 4, 1967 in order for AEC to declare the work complete. One of the punch list items was to remove an "apparently abandoned" haulage truck from the SLAPS.
- On April 14, 1967, the AEC wrote Hartford Accident & Indemnity Company stating that Continental had not responded to earlier letters so "we (AEC) would assume from our knowledge, that we can expect no further action by them, so that we must, apparently, look to you (Hartford) for finishing the work." Hartford apparently paid to complete the clean-up and AEC released their performance bond.

- In 1967, CDC attempted to sell the residues; there were no bidders. The residues at the HISS were estimated at 100,000 tons.
- From 1967 to 1968, CDC began drying the residues under an NRC license. The dried residues were shipped to Cotter Corporation facilities in Canon City, Colorado. By the end of 1968, 47,000 tons of residues had been shipped.
- In 1969, no activity took place at the HISS. The remaining residues were sold to Cotter Corporation.
- In 1969, the SLAPS was transferred to the St. Louis Airport Authority. The St. Louis Airport Authority demolished the existing buildings and buried the demolition debris on-site. The SLAPS was then covered with approximately 3 feet of clean fill. In 1970, this fill was trucked in from the construction of Lambert-St. Louis International Airport.
- In 1970, Cotter Corporation resumed drying operations and shipped all but 18,700 tons of residues to Canon City, Colorado.
- In 1973, the Cotter Corporation hired B & K Construction Inc. (B&K), a St. Ann, Missouri road construction company, to load the remaining residues onto rail cars for shipment to Cotter Corporation facilities in Canon City, Colorado. Approximately 10,000 tons of residues were shipped to Cotter Corporation in Canon City, Colorado without drying.
- In 1973, B&K disposed of the remaining residues (8,700 tons of leached barium sulfate cake) at the West Lake Landfill. It is uncertain what occurred. B&K billed Cotter for shipment of 50,000 tons, but B&K and others state that only 9,000 tons were actually sent to the landfill. The AEC was told that the remaining 8,700 tons of residue were mixed with 40,000 tons of soil prior to being sent to the landfill, but it does not appear that this actually occurred.
- In 1976 and 1977, the HISS (it was then know as the Latty Avenue site) was evaluated by the Nuclear Regulatory Commission for release for unrestricted use. Additional efforts were found to be needed.
- In 1984, the U.S. Department of Energy (DOE) issued a report titled *Post-Remedial Action Report* for the Hazelwood Site describing the testing performed to allow the cities of Berkeley and Hazelwood to design a new Latty Avenue road pavement and storm sewer system.
- In 1985, the DOE conducted mobile gamma scanning to detect any anomalies associated with the transportation routes between the Latty Avenue Properties and the West Lake Landfill. Impacts were found on McDonnell Boulevard, Pershall Road, and Hazelwood Avenue.
- In 1986, DOE directed Bechtel National, Inc. to provide radiological support to the cities of Berkeley and Hazelwood during the Latty Avenue road and storm sewer improvement project. During this time concentrations of radium-226 and thorium-230 contamination in excess of DOE remedial action guidelines were found along and under Latty Avenue. The asphalt pavement itself was also found to be impacted. The existing asphaltic concrete (AC) pavement was removed, as well as some of the material formerly under the pavement. A

new Portland Cement Concrete (PCC) pavement was constructed. The impacted material was removed and stockpiled on the HISS.

- In 1986, Oak Ridge National Laboratory (ORNL) issued a report entitled *Results of the Radiation Measurements Taken of Transportation Routes (LM004) in Hazelwood, Missouri.* This report indicated that anomalies were found along Pershall Road between Lindbergh Boulevard and Polson Lane, along Hazelwood Avenue between Pershall Road and Latty Avenue, and along McDonnell Boulevard between Byassee and Coldwater Creek. This study was a follow-up to the 1985 DOE mobile gamma scanning listed previously.
- In 1990, in a report entitled *Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri Area*, Bechtel National, Inc. (BNI) stated that, based on subsurface drilling and testing, "In general, radioactive contamination is present in some areas underneath Latty Avenue, McDonnell Boulevard, and Pershall Road, and contamination exists along both sides of Hazelwood Avenue and Pershall Road."
- In 1991, the DOE conducted mobile gamma scanning to detect anomalies. Anomalies were detected on McDonnell Boulevard, Pershall Road, and Hazelwood Avenue.

2.2 METHODS OF POSSIBLE IMPACT

The possible sources of residues which may have impacted materials, which are now under pavement, are listed below.

- Residue from SLDS was placed at SLAPS from 1946 through 1959.
- Residue was hauled by truck between the SLAPS and the HISS in 1966 and 1967.
- Fill material was brought by truck from airport construction projects to the SLAPS site and the empty trucks returned to the airport in 1969 and 1970.
- Residue was hauled by truck from the HISS to the West Lake Landfill in 1973.
- Storm water erosion from the SLAPS and the HISS site does not appear to have been rigorously controlled. Aerial photographs from the early 1950s show the SLAPS drainage ditches along interior roadways and around the stockpile areas, which discharge into Coldwater Creek. Storm water would have carried residue into these ditches and then into the Coldwater Creek floodplain.
- Wind erosion from the SLAPS and the HISS site does not appear to have been rigorously controlled. The residues stored at the SLAPS were reported to be in piles 20 to 25 feet in height, which would be higher than the surrounding terrain. The 20-foot height is given in a June 13, 1991 document by U.S. Department of Health and Human Services. This document states that "At the SLAPS site the uranium processing wastes were stored on open ground and once covered two-thirds of the area to an estimated height of 20 feet." A 25-foot height is given in a 1959 memo as the height of a "Pitchblende Raffinate stockpile".

2.2.1 How Impacts May Have Been Caused By Truck Transportation

Some possible mechanisms for the loss of residue during transportation by truck include, but are not limited to, spillage from trucks, dusting from driving at high speeds while hauling uncovered residue, and falling of residue and residue contaminated earth from vehicle undercarriages, beds, and wheels. Any areas adjoining traveled pavements not covered by other hard-surface pavements might have been impacted.

A conceivable, but unlikely, mechanism for contamination, would involve mechanical breakdowns or accidents involving the loaded trucks. In the event of an accident or breakdown of loaded vehicles, it is some times necessary for safety reasons that the load be dumped prior to repairing or towing of the vehicle. Should one of these uncommon occurrences have occurred involving a vehicle hauling residue if could have resulted in impact to areas on or near the roadways used to transport residues.

2.2.2 Protection of the Materials Under Pavements From Direct Impacts

Hard-surface pavements should have shielded the materials directly beneath them from direct impacts, while any areas adjoining hard-surface pavements (i.e., unpaved road shoulder and nearby unpaved areas) could have been impacted. Hard-surface pavements are considered to be portland cement concrete (PCC) or batch-mixed and -placed asphaltic concrete (AC) pavement of sufficient thickness to shield the material beneath. Oil-and-chip pavements, penetration AC pavements, or seal-coat-over-aggregate pavements are not considered sufficiently durable or nonporous to eliminate the potential for direct impacts to the material beneath them. Used in this report , unless otherwise noted, AC refers to batch-mixed and -placed AC of sufficient thickness and strength to prevent direct impacts to material beneath that pavement. Areas not covered with hard surface pavements could have been impacted. Those areas could have subsequently been paved as the result of new road construction, rending the impacted material under the later constructed pavement inaccessible.

2.2.3 Low Probability of Occurrence Mechanisms that Could Result in Impacts Under Road Pavements

There are several mechanisms that would result in impacts under otherwise impervious pavements. Such mechanisms would include those described below.

Placement of new utilities. It is a common practice to place utility services within public right-of-ways (ROWs) and sometimes under the road pavement. Such utility placement can result in the removal of the existing pavement, trenching, backfilling, and replacement of the paved surface. It is possible that the backfill material could be impacted material "borrowed" from nearby road ROW or that the excavated material would be stored on impacted ground and become impacted. Utilities could include, but would not be limited to, storm and sanitary sewers, water, gas, electric, and communications lines. Boring, jacking, or other underground tunneling methods could also be used to place such utilities. Therefore, any utility placement

could have resulted in the movement of impacted material to locations that were previously protected by pavement.

Repair of existing utilities. All utilities are subject to failure, and the repair and replacement of failed utilities could have resulted in the placement of impacted materials to locations that were previously protected by pavement. Water and sewer failures could also have resulted in the movement of impacted material within the soil.

Structural failure of pavement, AC, or PCC. Such a failure could have allowed a route for impacting agents to enter locations that are under the pavement. Also, the repair of structural failures generally requires the removal and replacement of the existing surface and any failed subgrade material. Pavement repairs could have resulted in the movement of possibly impacted material to locations that were previously protected by pavement.

Pavement reconstruction. Impacts could have also resulted when an existing impervious pavement was obliterated and a new pavement constructed to replace it. The construction activities of demolishing and removing the old pavement, the regrading of the new subgrade, and the construction of the new pavement could have moved impacted material from the former shoulder area to beneath the new pavement.

While the mechanisms listed above could result in impacts to material located under otherwise protective pavements, the conclusions of this report are based on the judgment that the chances of such impacts are too low to justify additional testing of inaccessible material under substantial pavements. The material under such hard-surfaced and impermeable pavements is considered to have been protected from direct impacts.

2.3 CONSIDERATIONS AND PROCEDURES

The purpose of this report is to identify those materials under currently existing pavements that may have been impacted by residue lost during residue hauling activities, residues transported by stormwater or wind erosion, and residues transported by stormwater flooding. This report includes determinations for where the testing of materials under the pavement could find such impacted material.

The conclusions of this report are based on the following considerations:

- Residues would not have directly impacted those areas protected by hard-surface pavements prior to 1946.
- Pavements constructed prior to 1966 would have protected the materials beneath them from direct impacts from the 1966 and 1967 hauling activities between the SLAPS and the HISS.
- Pavements constructed after 1966, adjacent to the 1966 and 1967 the SLAPS-to-the-HISS hauling routes could possibly have been placed over directly impacted materials.

- Pavements constructed after 1946 within the floodplain of Coldwater Creek downstream of the SLAPS could possibly have been placed over materials impacted by residue transported by water erosion and flooding.
- Pavements constructed after 1946 adjacent to the SLAPS could possibly have been placed over materials impacted by residue transported by wind erosion.

2.4 HISTORICAL FIELD-TESTING

- In 1985, ORNL issued a report entitled *Results of Mobile Gamma Scanning Activities in Berkeley, Bridgeton, and Hazelwood, Missouri*, which stated in part:

  "No anomalies were detected from the intersection of Pershall Road and Lindbergh Boulevard, Lindbergh Boulevard to Natural Bridge Road (Highway 115), and Natural Bridge Road to St. Charles Rock Road to the West Lake Landfill entrance. Also no anomalies were detected on North Hanley from I-270 to Airport Road, Airport Road, Frost Avenue, and Eva Avenue. Anomalies were detected on McDonnell Boulevard, south side, from Coldwater Creek to the intersection of Norfolk Southern Railroad crossing and on the north side of McDonnell Boulevard from the Berkeley city limits to Trumbell Asphalt sign near Byassee Road. Anomalies were detected along Pershall Road, south side, from the Ford Motor Company, new car parking area, to just past Polson Lane and on the north side of Pershall Road. Anomalies were also detected on Hazelwood Avenue, mainly on the west side of the street, in front of Wetterau Perishable Center approximately 115 feet south from the railroad crossing of Latty Avenue and one spot on the west side of Hazelwood Avenue".

- In 1986, ORNL issued another report, entitled *Results of the Radiation Measurement Taken of Transportation Routes (LM004) in Hazelwood, Missouri*. This report identified concentrations of higher-than-background radiation readings on McDonnell Boulevard between Coldwater Creek and Byassee Road, on Hazelwood Avenue north of Latty Avenue, and on Pershall Road between Polson Road and Lindbergh Boulevard. These were the only routes surveyed for this report.
- In 1990, in a report entitled *Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri Area*, Bechtel National, Inc. stated that, based on subsurface drilling and testing, "In general, radioactive contamination is present in some areas underneath Latty Avenue, McDonnell Boulevard, and Pershall Road, and contamination exists along both sides of Hazelwood Avenue and Pershall Road."
- In 1991 DOE conducted mobile gamma scanning surveys to detect any anomalies associated with the transportation routes around the SLAPS. The following roads near the SLAPS were scanned:

  St. Charles Rock Road from Fee Fee Road to Taussig Road
  Fee Fee Road from St. Charles Rock Road to McDonnell Boulevard
  Taussig Road from St. Charles Rock Road to Gist Road
  Gist Road from Taussig Road to Garret Road
  Garret Road from Gist Road to Missouri Bottom Road
  Natural Bridge Road from St. Charles Rock Road to Lindbergh Boulevard

Lindbergh Boulevard from Natural Bridge Road to McDonnell Boulevard
Banshee Road from Lindbergh Boulevard to McDonnell Boulevard
McDonnell Boulevard from Lindbergh Boulevard to Airport Road
McDonnell Boulevard from Fee Fee Road to Dunn Road
Dunn Road from McDonnell Boulevard to Lindbergh Boulevard
Pershall Road from Lindbergh Boulevard to North Hanley Road
North Hanley Road from Dunn Road to Airport Road
Airport Road from North Hanley Road to McDonnell Boulevard
Eva Avenue from McDonnell Boulevard to Frost Avenue
Hazelwood Avenue from Frost Avenue to Pershall Road
Frost Avenue from Eva Avenue to North Hanley Road
Latty Avenue from the HISS to North Hanley Road

The results were issued in a report titled *Results of Mobile Gamma Scanning Activities in St. Louis, Missouri. ORNL.* This report also collected results from and discussed all of the prior mobile gamma scanning testing activities. Figures illustrating the roads, which were scanned, are reproduced as Figures 2-1, 2-2, and 2-3. Figure 2-1 shows the general location of the Mallinckrodt Chemical Plant and the SLAPS, the HISS, and West Lake Landfill storage sites, St. Louis, Missouri. Figure 2-2 is a diagram of routes scanned in the vicinity of the Mallinckrodt Chemical Plant site, St. Louis, Missouri. Figure 2-3 is a diagram of routes scanned by ORNL and routes characterized by BNI. in the vicinity of the Lambert-St. Louis International Airport, St. Louis, Missouri.

- This survey found no anomalies on the suspected haul routes in the vicinity of the Mallinckrodt plant that could not be explained by factors other than haulage activities. The survey found impacts along Latty Avenue from the HISS to Graham Road and confirmed the impacts found along other haul routes in past surveys.

2.4.1 Results Of Initial Testing Under Roads

At least 1,632 samples have been collected in areas that are in or near existing road pavements. Of these, 127 have individual test results exceeding remediation goals proposed in the Record of Decision for unrestricted release. These points are shown on the drawings contained in the appendices. These data were obtained from the FUSRAP primary sample database and represent the test results from many sources compiled into a common electronic format.

Figure 2-4 shows the roadways in or around which residue has been detected that may exceed remediation goals in the proposed Record of Decision.

Figure 2-1 General Location of the Mallinckrodt Chemical Plant and the SLAPS, HISS, and West Lake Landfill Storage Sites in St. Louis, Missouri

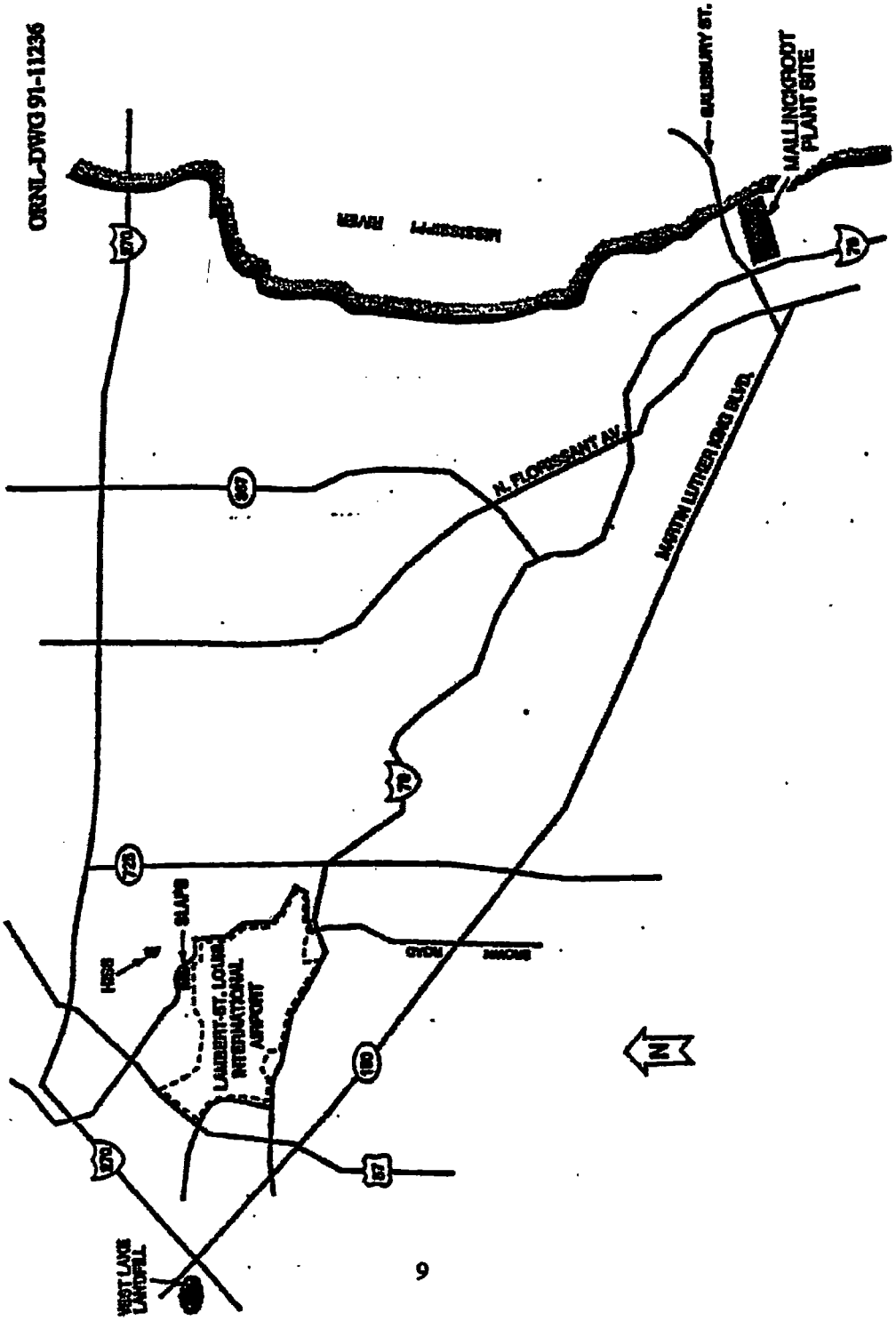


Figure 2-2 Diagram of Route Scanned in the Vicinity of the Mallinckrodt Chemical Plant Site, St. Louis, Missouri

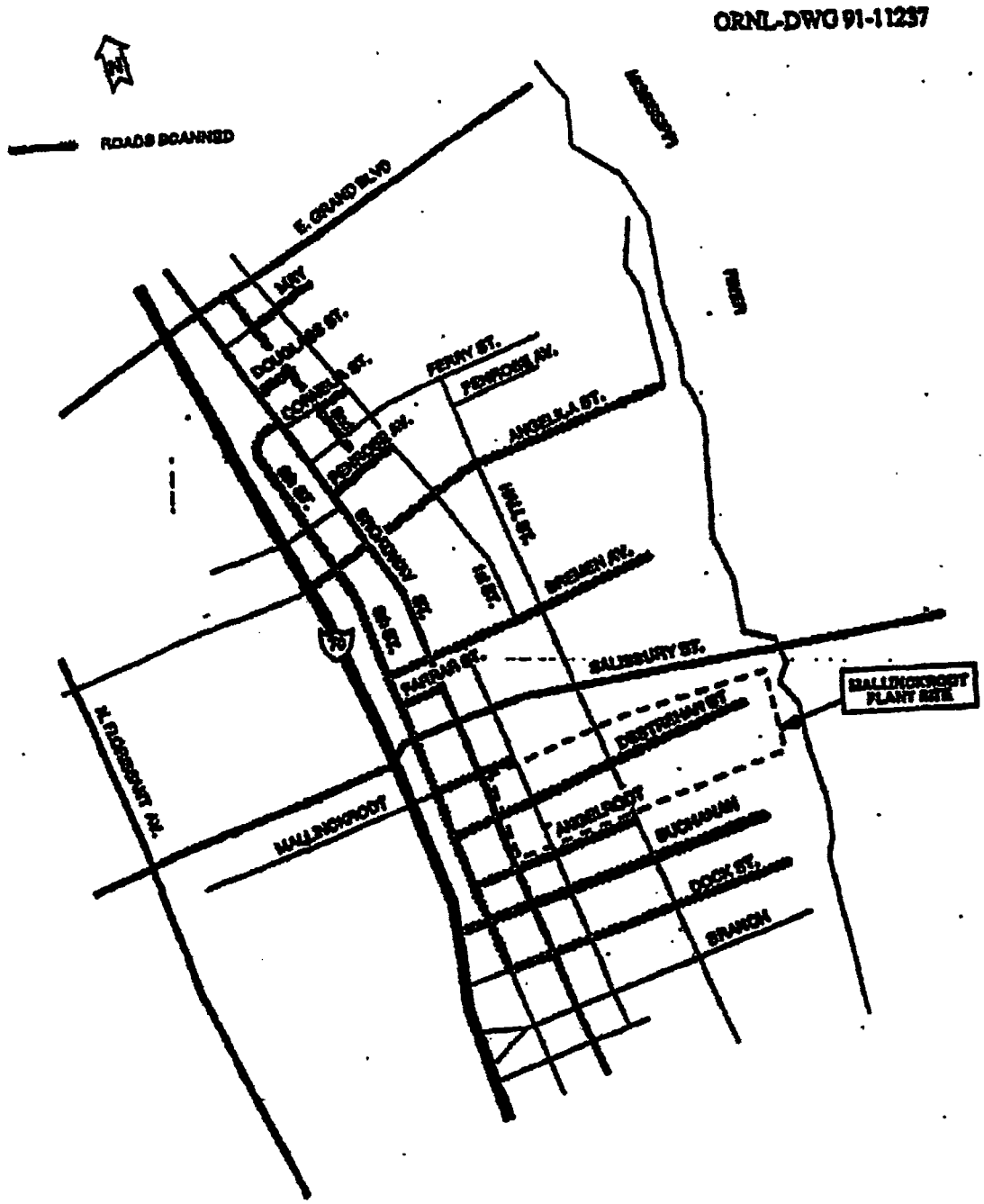
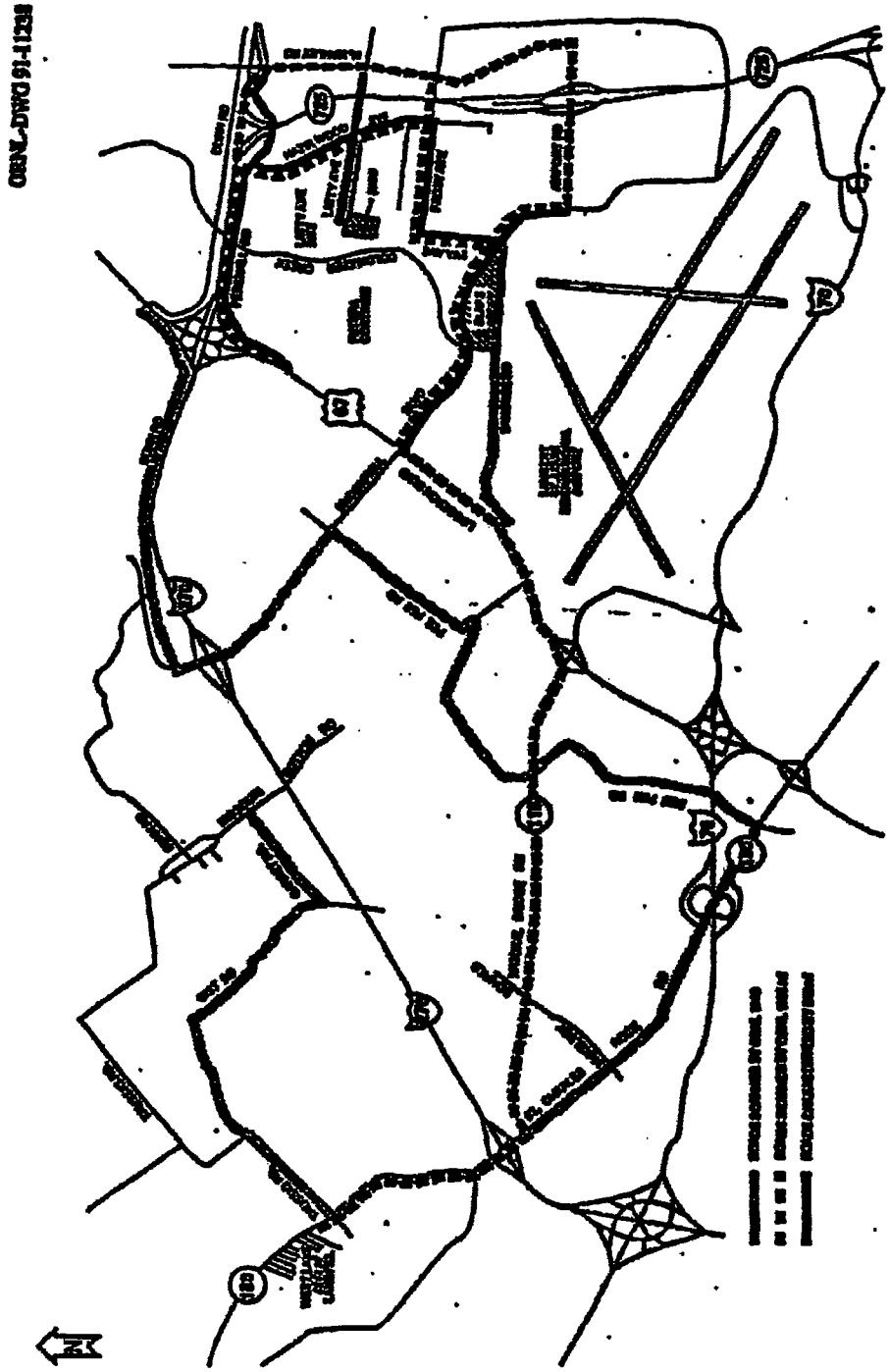
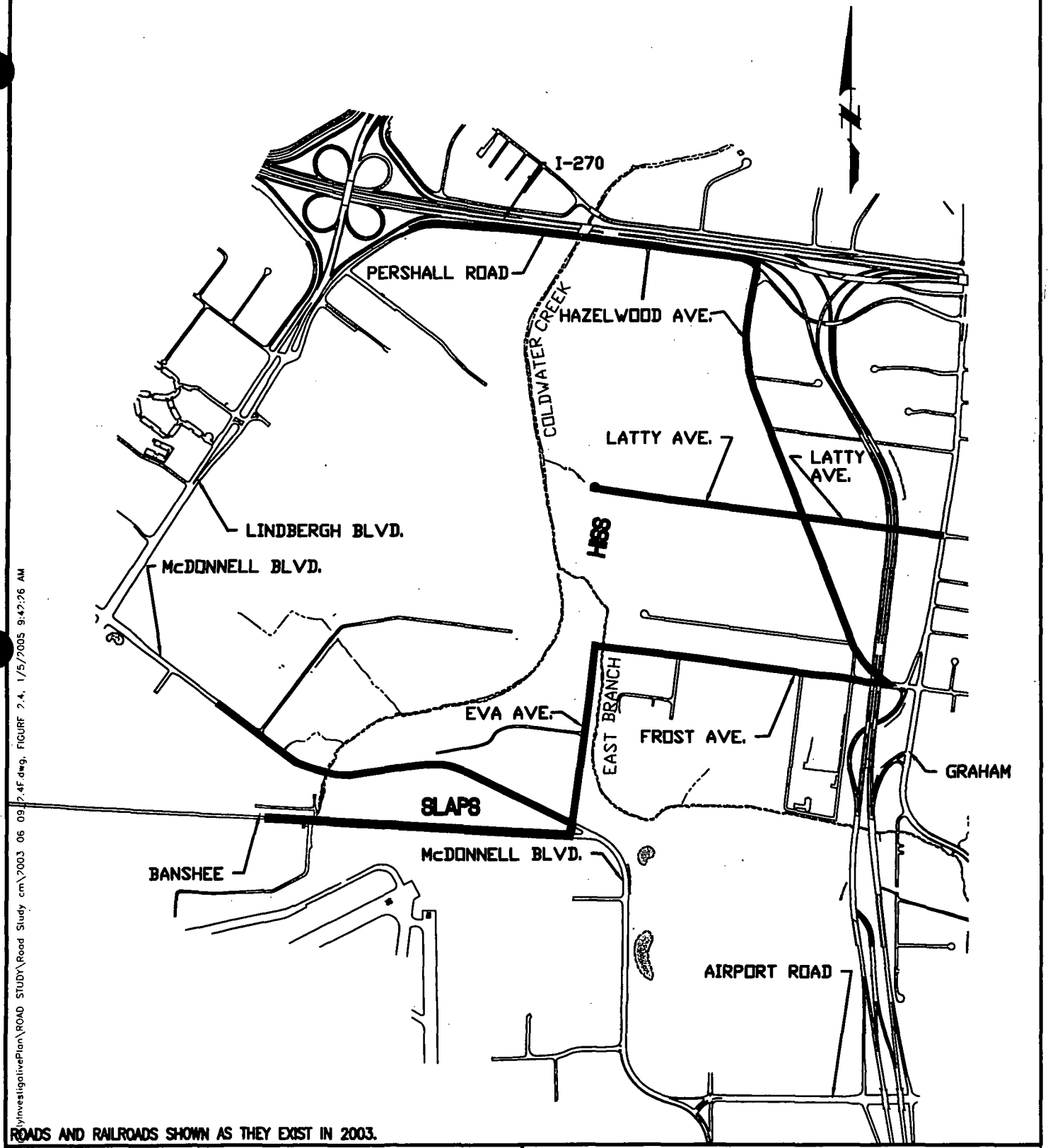


Figure 2-3 Diagram of Routes Scanned by Oak Ridge National Laboratory and Routes Characterized by Bechtel National, Inc. in the Vicinity of the Lambert-St. Louis International Airport, St. Louis, Missouri





ROADS AND RAILROADS SHOWN AS THEY EXIST IN 2003.

U:\CAD\NorthCo\Dwgs\HaulRoutePl...\InvestigativePlan\ROAD STUDY\Road Study cm\2003 06 09 2.4F.dwg, FIGURF 2.4, 1/5/2005 9:42:26 AM

LEGEND:

IMPACTED

0 500 1000 1500 3000

SCALE: 1" = 1500'

SAIC®
Science Applications International Corporation

FIGURE 2-4

LOCATIONS OF IMPACTS FOUND BY TESTING

J.D.L.	REV. NO./DATE: FINAL/01-07-05	CAD FILE:

2.5 HAUL ROUTES BETWEEN THE SLAPS AND THE HISS/FUTURA SITE

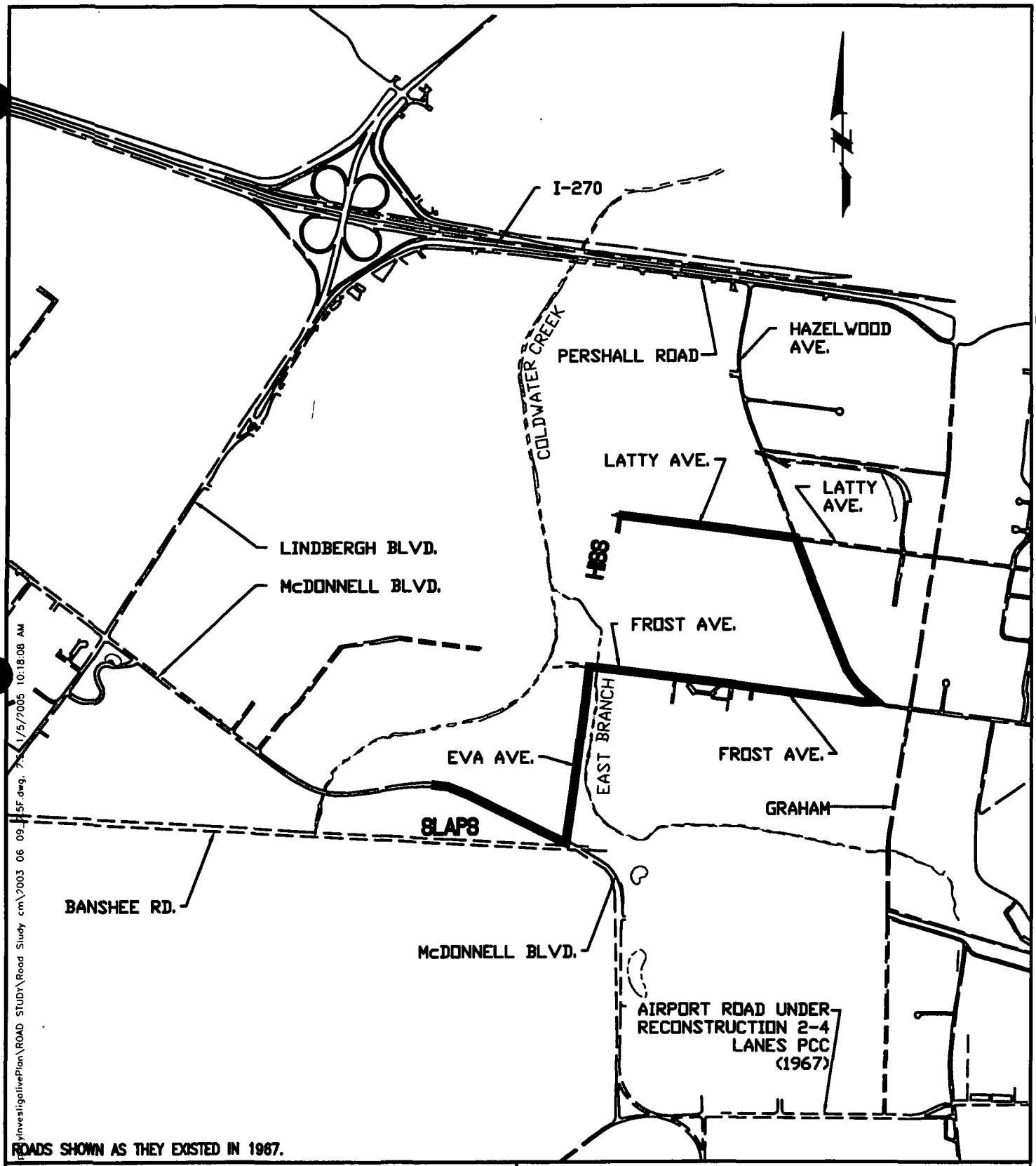
In transporting residue between the SLAPS and the HISS, the probable roads traveled include Eva Avenue, Hazelwood Avenue, Latty Avenue, Frost Avenue, I-270, Lindbergh Boulevard (also known as (aka) Highway 66/67), McDonnell Boulevard (aka Brown Road, State Route TT or STT), Pershall Road (aka I-270 South Outer Road), Dunn Road (aka I-270 North Outer Road), Graham Road (aka North Hanley Road), and Airport Road.

While there are many potential routes to get from one site to the other, the most direct route involves a portion of McDonnell Boulevard from the SLAPS to Eva Avenue, Eva Avenue to Frost Avenue, Frost Avenue to Hazelwood Avenue, Hazelwood Avenue to Latty Avenue, and Latty Avenue to the HISS (Route A). Route A is illustrated in Figure 2-5.

The photographic information examined shows evidence of wear consistent with heavy truck hauling on Eva, Frost and Latty avenues during the period consistent with the 1966 and 1967 hauling activities between the SLAPS and the HISS. It seems likely that the greatest potential for impacts would have occurred along the route described above. Reports from eyewitnesses to the hauling activities indicate that the trucks did use this route, except during periods of wet weather.

When the hauling activities did not use Route A, because of weather-related effects on the hauling roads, train traffic blocking the Frost Avenue crossing, or some other reason, other possible routes might have included those listed below. Since Eva Avenue and part of Frost Avenue were unimproved dirt roads at that time, they may not have been passable in times of prolonged wet weather.

- Route B - McDonnell Boulevard to Lindbergh Boulevard, Lindbergh Boulevard to Pershall Road, Pershall Road to Hazelwood Avenue, Hazelwood Avenue to Latty Avenue. This route is illustrated in Figure 2-6.
- Route C - McDonnell Boulevard to Lindbergh Boulevard, Lindbergh Boulevard to Pershall Road, Pershall Road to Graham Road, Graham Road to Latty Avenue. This route is illustrated in Figure 2-7.
- Route D - McDonnell Boulevard to Lindbergh Boulevard, Lindbergh Boulevard to I-270, I-270 to Graham Road, Graham Road to Latty Avenue. This route is illustrated in Figure 2-8.
- Route E - McDonnell Boulevard to Airport Road, Airport Road to Graham Road, Graham Road to Frost Avenue, Hazelwood Avenue to Latty Avenue. This route is illustrated in Figure 2-9.
- Route F - McDonnell Boulevard to Airport Road, Airport Road to Graham Road, Graham Road to Latty Avenue. This route is illustrated in Figure 2-10.



ROUTE LENGTH = 2.15 MI.

LEGEND:
IMPACTED

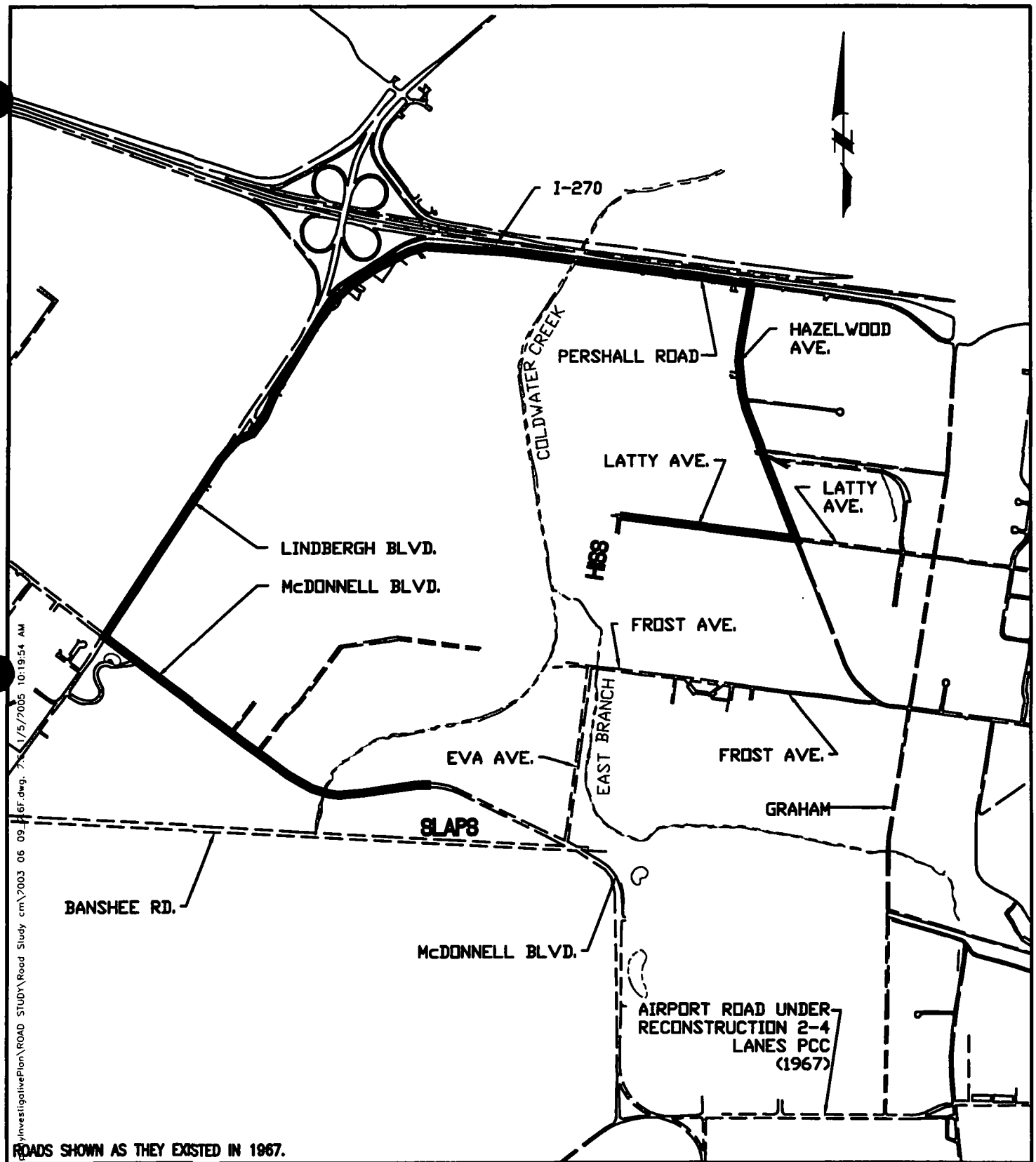
0 500 1000 1500 3000
SCALE: 1" = 1500'

Science Applications International Corporation

ROUTES BETWEEN SLAPS AND HISS
ROUTE A
MOST DIRECT ROUTE

FIGURE 2-5

J.D.L.	REV. NO./DATE: FINAL/01-07-05	CAD FILE:

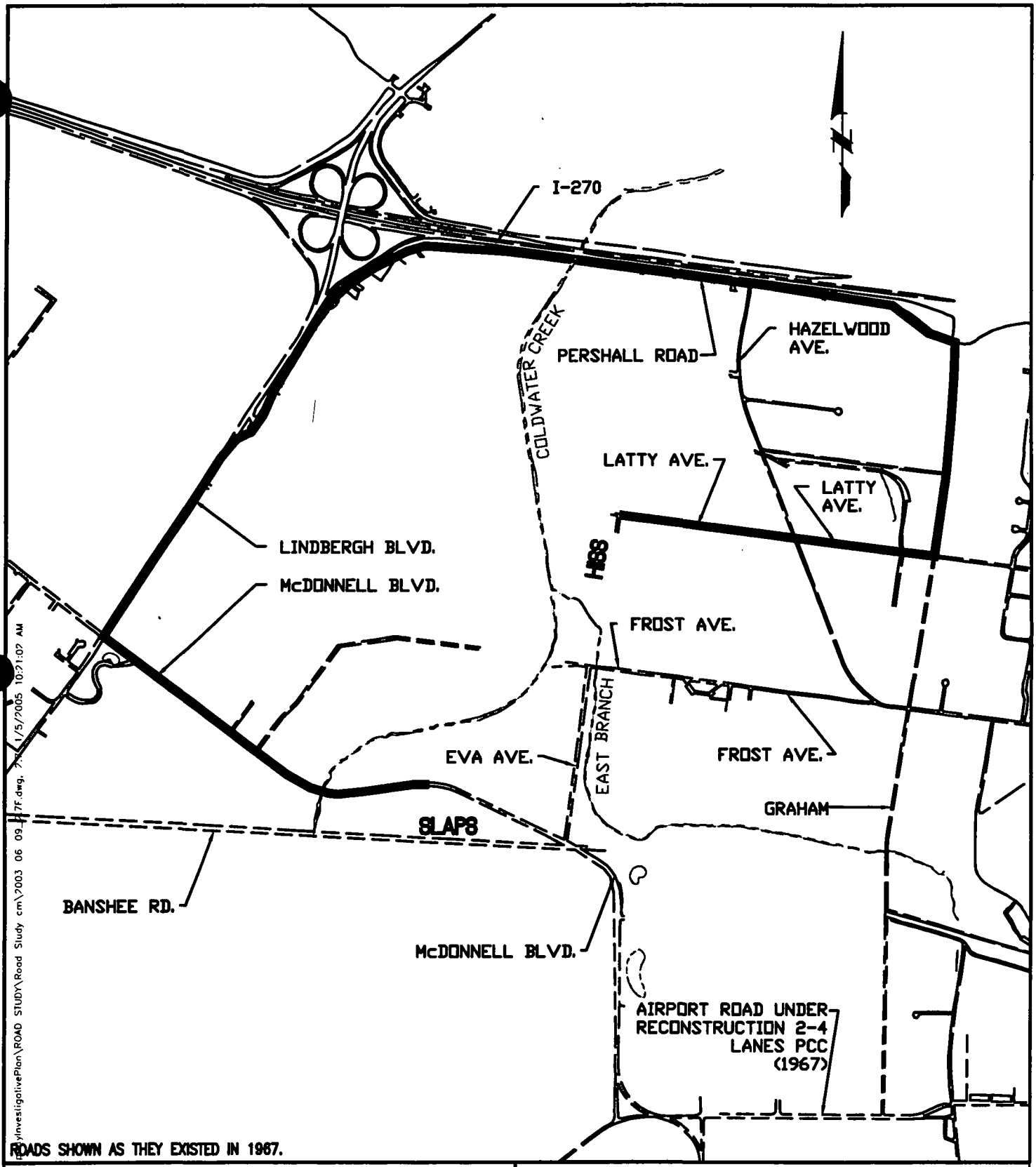


Science Applications International Corporation

ROUTES BETWEEN SLAPS AND HISS
ROUTE B

FIGURE 2-6

J.D.L.	REV. NO./DATE: FINAL/01-07-05	CAD FILE:



ROADS SHOWN AS THEY EXISTED IN 1967.

LENGTH=4.33 MILES

LEGEND:
IMPACTED

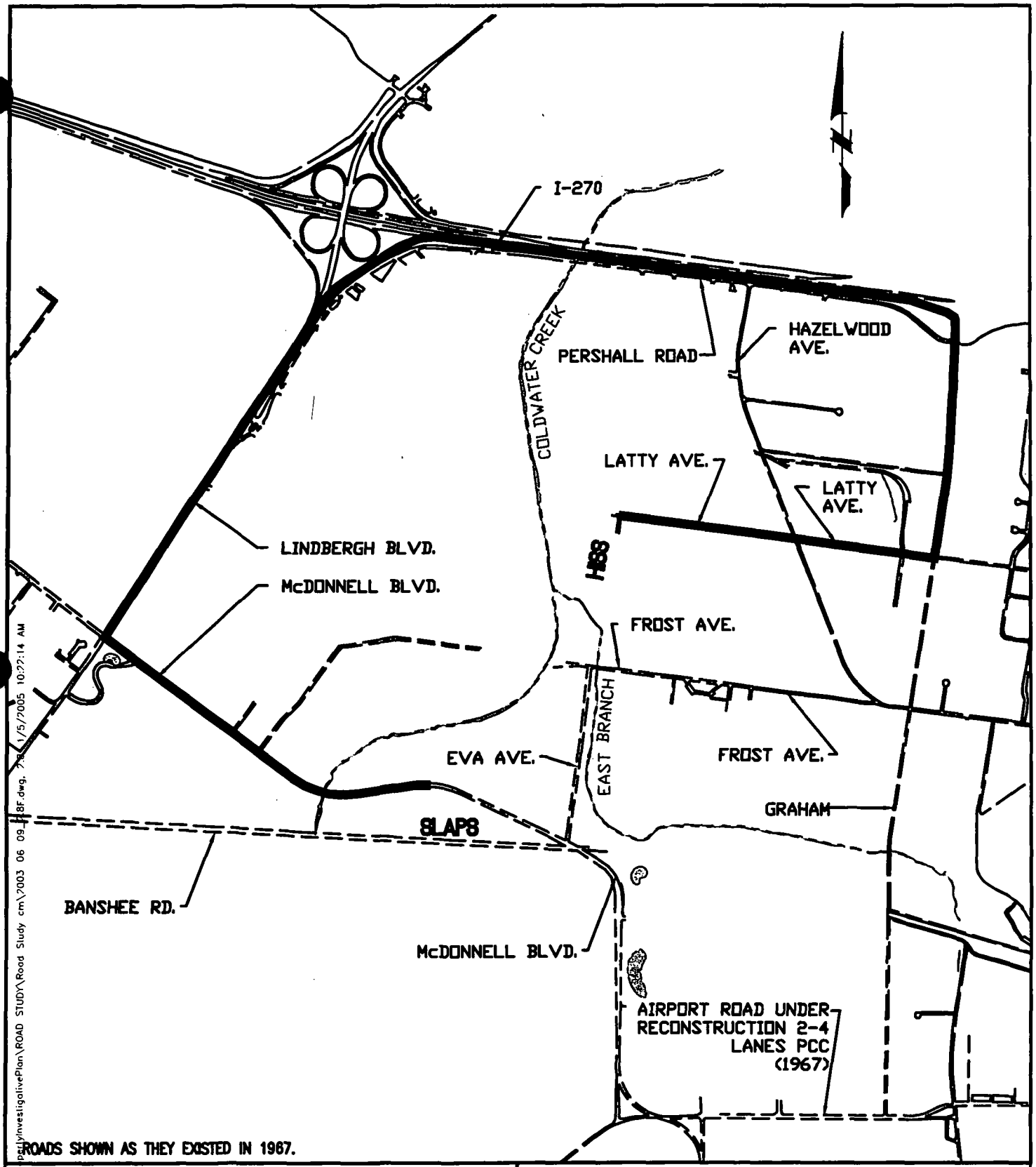
0 500 1000 1500 3000
SCALE: 1" = 1500'

Science Applications International Corporation

ROUTES BETWEEN SLAPS AND HISS
ROUTE C

FIGURE 2-7

J.D.L.	REV. NO./DATE: FINAL/01-07-05	CAD FILE:



LENGTH= 4.38 MI.

LEGEND:

IMPACTED

0 500 1000 1500 3000

SCALE: 1" = 1500'

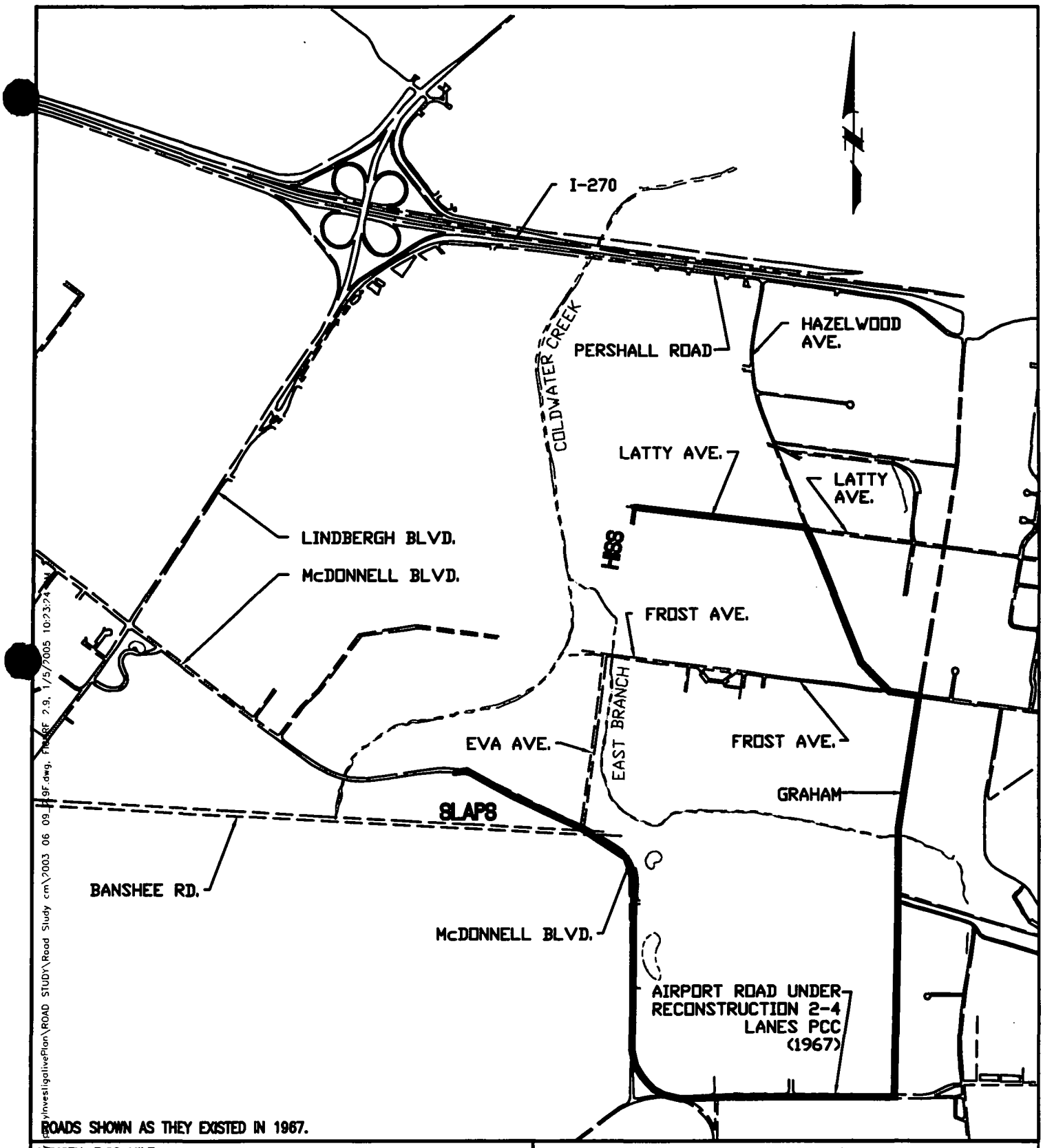
Science Applications International Corporation

FIGURE 2-8

ROUTE BETWEEN SLAPS AND HISS
ROUTE D

J.D.L	REV. NO./DATE: FINAL/01-07-05	CAD FILE:

U:\CAD\NorthCo\Dwgs\HaulRoutes\Presly\InvestigativePlan\ROAD STUDY\Road Study cm\2003 06 09_HISS.dwg, 1/5/2005 10:22:14 AM

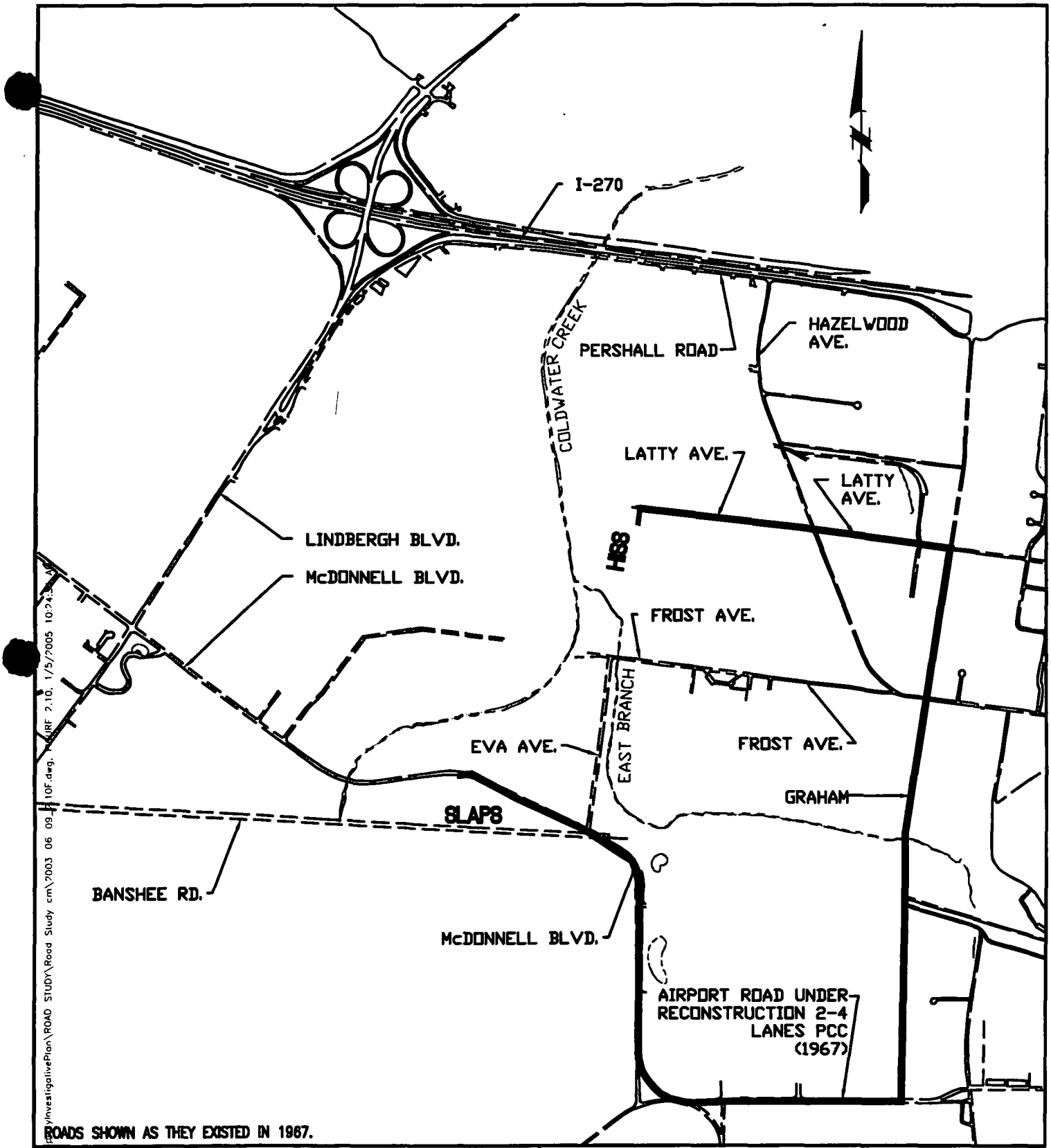


SAIC®
Science Applications International Corporation

FIGURE 2-9

ROUTE BETWEEN SLAPS AND HISS
ROUTE E

J.D.L.	REV. NO./DATE: FINAL/01-07-05	CAD FILE:



LENGTH=3.4 MILES

LEGEND:

IMPACTED

0 500 1000 1500 3000

SCALE: 1" = 1500'

Science Applications International Corporation

FIGURE 2-10

ROUTE BETWEEN SLAPS AND HISS
ROUTE F

J.D.L	REV. NO./DATE: FINAL/01-07-05	CAD FILE:

J:\NorthCo\Dwgs\HaulRoute\InvestigativePlan\ROAD STUDY\Road Study cm\2003 06 09_HRF 2.10, 1/5/2005 10:24:

2.5.1 Evaluation of Haul Routes Between the SLAPS and the HISS

It is the conclusion of this report that Route A would have been the most heavily used route. If Route A were not available, then Route B would be the next most reasonable route. Routes E and F were also reasonable routes; however, there are construction plans, completed in July 1966, for a major reconstruction of Airport Road. It is our judgment that this work would have been placed out for bid in 1966 or 1967, making it likely that Airport Road was under construction when the SLAPS to the HISS haulage activities occurred. Residue hauling could have used Airport Road before construction started, during the Airport Road reconstruction, or after construction was finished. However, this use would be considered less likely than the use of Route B. Routes C and D cannot be ruled out but appear to offer no advantage over shorter routes. Impacts have been found on Latty Avenue east of Hazelwood Avenue. For such impacts to have occurred some haulage would have had to use Routes C or F. Table 2-1 compares routes A through F.

Table 2-1 Comparison of Haul Routes Between the SLAPS and the HISS

ROUTE	LENGTH	COMMENTS
Route A	2.15 miles	Most direct route
Route B	3.60 miles	A reasonable route
Route C	4.33 miles	No known advantage over shorter routes.
Route D	4.38 miles	No known advantage over shorter routes.
Route E	3.28 miles	A reasonable route. However, Airport Road believed to be under construction 1966 to 1967.
Route F	3.44 miles	A reasonable route. However, Airport Road believed to be under construction 1966 to 1967

2.5.2 Methods for Transporting Residues Between the SLAPS and the HISS

According to an August 15, 1967 memo titled *Historical Review of the Mallinckrodt Airport Cake,* believed to be from the Congress of the United States, House of Representatives, Committee for Public Works and Transportation, Science and Technology, the residues were moved from the SLAPS to the HISS by Continental Mining and Milling of Chicago, Illinois. This move required ten dump trucks for five months and cost Continental $100,000.

In a bid dated December 27, 1965, from Braun Excavating Company (Braun) to Contemporary and Continental, Braun made the following statement:

> The unit price quoted includes loading of material into trucks at the existing stockpile area, transporting same to the new stockpile area, unloading and stockpiling. We anticipate washing down the truck wheels before entering the public road, utilizing the existing wash facilities at the Brown Road location. We further anticipate the necessity of keeping a bulldozer and operator at the General Electric plant site to stockpile the material as it is dumped, and the second washing down of the truck wheels before again entering the road.
> Items which we have not included in our Per Ton price quotation, and which are to be borne by other, are as follows:

a. Truck washing facilities at both present and future stockpile areas.

b. Water used for washing trucks.

c. Additional hazard insurance coverage over and above our present standard workman's compensation, and comprehensive liability coverage.

d. Required periodic medical examinations, special wearing apparel, etc., for employees.

e. Weighting facilities for trucks at either location, and wages for scale man.

f. Any special material, such as wax paper, oil, sand, etc., required to facilitate dumping of material from trucks.

g. Facilities to be used by employees for washing, showering, and changing of apparel.

It is likely that the actual hauling activities in 1966 and 1967 were conducted using methods similar to the above. The residue would have been carried in over-the-road dump trucks. Loading of the trucks would have been by portable conveyor system or front-end loader. Either method would have produced dust.

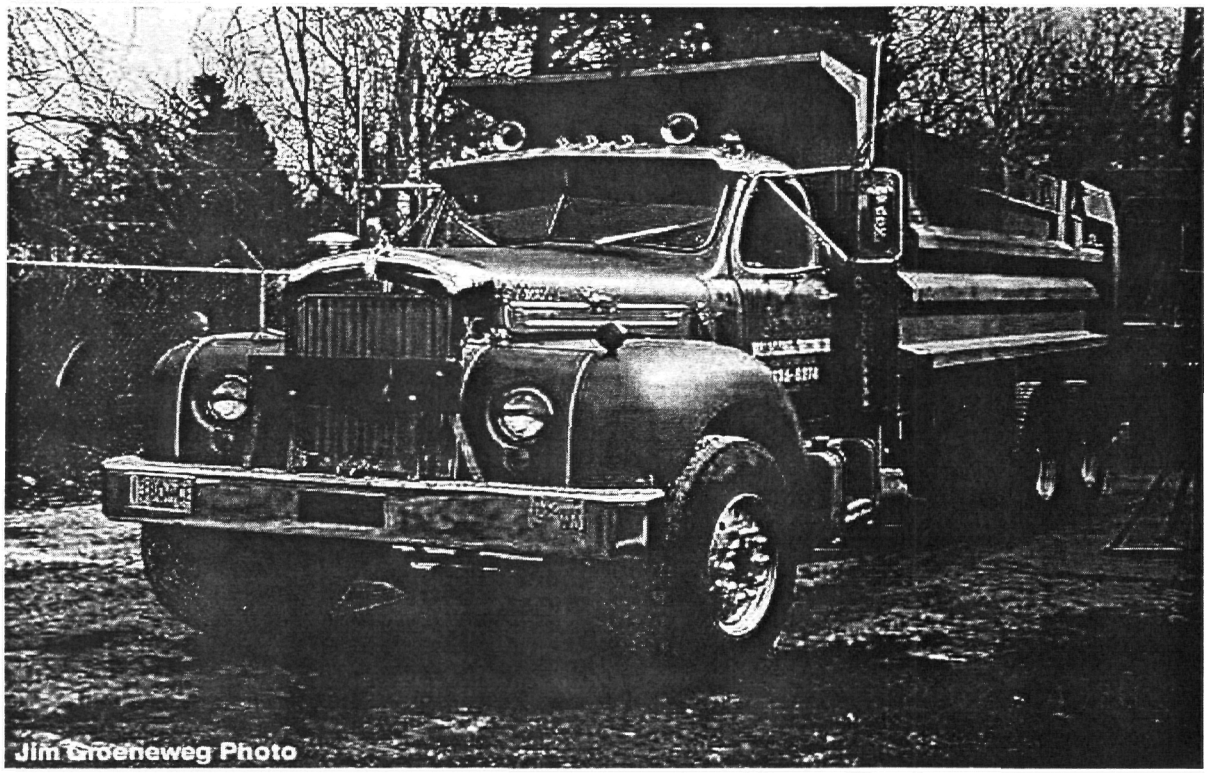
Braun's bid price for this work was $1.25 per ton. The contractor who actually performed this work in 1967 for Continental was paid $100,000, which would be approximately $0.85 per ton.

It is believed that the trucks used would have been 20-ton dump trucks, similar to the one shown in Illustration 2.1; however, no documented evidence concerning the actual type of equipment used, other than that the equipment used for transport was "dump trucks", has been located to date.

An indication of the level of dust control expected in this work in the mid-1960s comes from a United States Memorandum dated July 25, 1967, entitled *Requirements for Surface Cleanup of the Airport Site,* which states

> ...the following should be considered the general plan for decontamination, which the Airport Commission will be required to follow. It is noted that none of the clean-up operations are of such nature to require film badging or protective precautions other than ordinary personal hygiene practices. All trucking operations shall be conducted in a manner to assure minimum dusting. This can be easily accomplished by wetting down truckloads prior to departure.

Illustration 2.1



Typical 1960 20-Ton Over-the-Road Dump Truck

The information available indicates that the hauling of materials from the SLAPS to the HISS required 10 dump trucks for a period of five months. A typical 1960 era 20-ton dump truck is shown in Illustration 2.1 above. This type of truck has a bed capacity of 12 cubic yards. Dry loose earth has a typical weight of 2,000 pounds per cubic yard. Heavy wet mud has a typical weight of 3,000 pounds per cubic yard. Assuming a weight for the residue of 2,500 pounds and that each truck was loaded with 12 yards of material would mean that each truck load would carry about 15 tons of material. The trucks would need to be heaped to carry the 20 tons capacity. It is common practice for each truck to carry the maximum possible load. If the material were heaped it would increase the chance of dusting and spillage from the truck bed. To move the 120,000 tons of residue would have required between 6,000 and 8,000 trips.

2.5.3 Conclusions

The primary means of transport of residue between the SLAPS and the HISS was by means of dump trucks. The most probable route for transport of residues between the SLAPS and the HISS was Route A, from the SLAPs to McDonnell Boulevard to Eva Avenue, Eva Avenue to Frost Avenue to Hazelwood Avenue, Hazelwood Avenue to Latty Avenue as shown in Figure 2-5. However, Routes B, E, and F, as shown in Figures 2-6, 2-9 and 2-10, were also used. These routes appear to have offered the quickest and most economical routes between the SLAPS and the HISS in 1966 and 1967.

McDonnell Boulevard must have been used as a haul route. McDonnell Boulevard is the only road access to the SLAPS.

Lindbergh Boulevard must have been used as a haul route, since impacts have been found on McDonnell Boulevard west of Coldwater Creek. The impacted areas on McDonnell Boulevard cannot be explained by wind or stormwater action. The impacts must be the result of haulage activities. Lindbergh Boulevard has undergone extensive widening and reconstructions since that time and any impacts to the shoulders in 1967 or earlier would now be under pavement.

Graham Road must also have been used as a haul road, since impacts have been found along portions of Latty Avenue east of Hazelwood Avenue. The impacted areas on Latty Avenue east of Hazelwood Avenue cannot be explained by wind or stormwater action and must be the result of haulage activities. This haulage activity must have occurred as part of the 1966 and 1967 haulage of residues from the SLAPS to the HISS. There are two possible routes from the SLAPS to the HISS involving Graham Road. One route would have entered Graham Road from I-270 or Pershall Road and proceeded south on Graham Road. This portion on Graham Road has been obliterated and been totally reconstructed as the much wider North Hanley Road. Any impacts to the shoulders of Graham Road in 1967, where it has been replaced with North Hanley Road, would now be under the North Hanley Road pavement.

The second route would use Graham Road by way of Airport Road and proceed north on Graham Road. Airport Road was undergoing reconstruction in 1966 and 1967 and would have likely been an undesirable haul route because of the construction-related delays likely to be encountered in the use of this route. A portion of the pre-North Hanley/Graham Road pavement is still in existence. The portion in existence also contains the location of a former railroad crossing of the Norfolk Southern mainline.

2.6 RESEARCH SUMMARY

Documents were obtained and reviewed from a number of sources. Among the records reviewed were aerial photographs, construction plans, road maintenance records, county tax records, highway maps, United States Geological Survey (USGS) quad maps, and historical documents.

One key document was a 1992 United States Environmental Protection Agency (EPA) Region VII study entitled *Aerial Photographic Analysis of the St. Louis Airport Study Area, Hazelwood, Missouri.* This document contains a collection of aerial photographs from the years 1941, 1953, 1965, 1971, 1974, 1980, 1984, 1985, and 1990 showing the HISS and the SLAPS and some of the surrounding roads. Each photograph is accompanied by an analysis of the work being done on or around the sites at each particular time. These photographs of the sites were indispensable in determining what had occurred on the roads over time. While these photographs provide excellent coverage of the roads immediately adjacent to the SLAPS and the HISS, they do not always extend far enough to cover Route 67 (aka Lindbergh Boulevard), Airport Road, North Hanley Road, or I-270. In addition, the scale of the photographs is very large, with 1 inch equal to 1,000 feet and 1 inch equal to 2,000 feet being the most common.

This large scale made it difficult to determine with certainty the condition and type of the road surface.

Additional aerial photographs were obtained from St. Louis County. These aerial photographs were 1 inch equal to 200 feet or 1 inch equal to 400 feet in scale. St. Louis County has aerial photographs available from 1966, 1981, 1985, 1990, 1993, 1995, and 1997. The 1966 (1 inch equal to 200 feet) and 1997 (1 inch equal to 400 feet) photographs were copied and reviewed for the purposes of this report. The other photographs were from periods in which other coverage was available or covered times of lesser interest and, therefore, were not purchased for review.

Aerial photographs were also obtained in electronic form from Surdex Corporation, a St. Louis-based aerial photogrammetry firm. These photographs were from 1965, 1971, 1973, 1975, and 1997. The figures included in the appendices use the 1997 aerial photographs as background and also show the outline of the pavement from the 1965 photographs.

All of these aerial photographs were used to determine what generally occurred on the roadways over time. The interpretation of this type of information is, by necessity, subjective. The photographic data available for review is listed in Table 2-2.

Construction plans and maintenance records provide more objective and detailed information to supplement the interpretation of the aerial photographs. The dates available are from the fiscal year in which the projects were funded for construction, and those are the dates used in this report. The actual date of construction might be as many as several years later. The information from the construction and maintenance records was used in preference to the aerial photographs wherever possible; however, for some of the roads, the aerial photographs were the only records available. Those aerial photographs available are listed in Table 2-2.

Table 2-2 Aerial Photographs Available

YEAR	SCALE	USED	SOURCE	COMMENTS
1941	1:11000	Yes	1992 EPA Study	
1953	1:20,350	Yes	1992 EPA Study	
1958	1:10,895	Yes	1992 EPA Study	
1965	CADD	Yes	Surdex Corporation	
1965	1:11,110	Yes	1992 EPA Study	
1966	1:2400	Yes	St. Louis County	
1971	1:10,825	Yes	1992 EPA Study	
1971	CADD	No	Surdex Corporation	
1973	CADD	No	Surdex Corporation	
1974	1:12,115	Yes	1992 EPA Study	
1975	CADD	No	Surdex Corporation	
1980	1:7,777	Yes	1992 EPA Study	

Table 2-2 Aerial Photographs Available (Cont'd)

YEAR	SCALE	USED	SOURCE	COMMENTS
1981	1:4800	No	St. Louis County	
1984	1:6,060	Yes	1992 EPA Study	Color Photograph
1985	1:8,290	Yes	1992 EPA Study	
1985	1:4800	No	St. Louis County	
1990	1:4800	No	St. Louis County	
1993	1:4800	No	St. Louis County	
1995	1:4800	No	St. Louis County	
1997	1:4800	Yes	St. Louis County	Believed same as Surdex CADD below
1997	CADD	Yes	Surdex Corporation	

For those roadways that are part of the state of Missouri highway system (e.g., I-170, I-270, (I-270 includes Dunn Road as the north outer road and Pershall Road as the south outer road), Lindbergh Boulevard (State Route 67), and McDonnell Boulevard (State Route TT), a key resource was the Missouri Department of Transportation (MoDOT) pavement history drawings. These drawings show the project year and type of road surface constructed. Equally important, they provide the construction project number, which is the key to MoDOT's microfilm system of the old construction plans for those highways. Only selected construction plans were obtained for this report, but should a greater level of detail be desired in the future, additional plans are available.

The pavement history drawings obtained from MoDOT were as follows:

096 St. Louis Sheet 8 of 31 covering I-170
096 St. Louis Sheet 11 of 31 covering Lindbergh Boulevard (State Route 67)
096 St. Louis Sheet 20 of 31 covering I-270
096 St. Louis Sheet 25 of 31 covering McDonnell Boulevard (State Route TT)

Selected highway construction plans were obtained for portions of I-170, Lindbergh Boulevard, I-270, Pershall Road, and McDonnell Boulevard. Additional details of the plans reviewed are provided in the appendices with the associated roads. These plans were also used to help determine the ROW widths and whether fill was placed on impacted material.

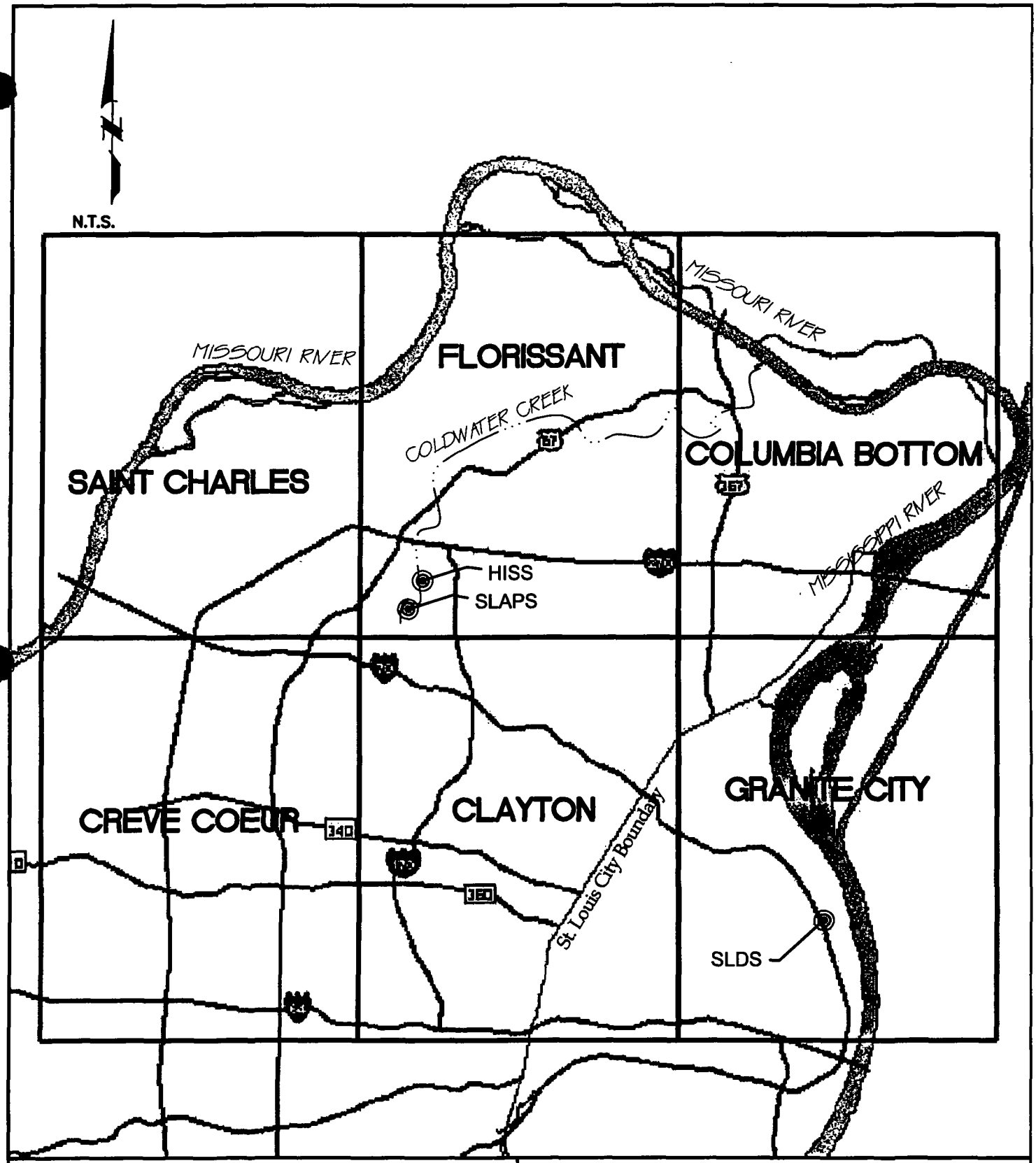
Selected St. Louis County Land Information Services maps were also obtained. These computer-aided design and drafting (CADD) drawings are at a 1-inch equal to 400 feet scale and show street and road ROWs and property boundaries of all parcels. They also list the St. Louis County Locator Number for each parcel. With the locator number, the owner of record, last recorded deed, zoning, and other information can be obtained from the St. Louis County Web site. The reliability of the information from the county tax assessor's office, however, must be considered low. The assessor's office makes no warranty as to its accuracy, and the quality

assurance of the input of this information is poor. For certainty in property boundary-line location, a registered land surveyor, using the latest property boundary description of record, surveyed property monument locations, and the historical chain of title for that parcel, should locate boundary and ROW lines in the field. The maps obtained were Map Panels 9-K, 9-L, 10-K, 10-L, 11-K, and 11-L.

In addition, selected tax assessor's maps were obtained. These hand-drawn and hand-updated drawings are at various scales, with 1 inch equal to 150 feet being the most common. These drawings have the dimensions of the property boundary lines, acreages, county location number, record owner, existing buildings and pavements, and recording information of deeds or plats. The quality assurance of these records is also poor, but they do provide some additional information. These linens are quite old, and some times provide a historical record of what might have occurred on a parcel over time. These drawings certainly predate any work at the SLAPS or the HISS. The panels obtained were Map Numbers Ferguson-Florissant R-2 6, 7 and Hazelwood 237, 238, 245, 247b, 249, 250.

Historical highway maps were obtained from the COE. The maps obtained were dated 1952, 1965, and 1976.

Historical mapping from the USGS reviewed included the maps listed below. Figure 2-11 shows the six USGS quadrants of primary interest.



LEGEND:

RELATIONSHIP BETWEEN USGS 1"=2000' QUAD MAPS.

——·····—— CREEK

U:\CAD\NorthCo\Dwgs\HaulRoutePl

Science Applications International Corporation

FIGURE 2-11

USGS QUAD MAP LOCATIONS

J.D.L.	REV. NO./DATE: FINAL/01-07-05	CAD FILE:

Clayton Quad Map

1941 (photographed 1933)	roll 079, frame 321
1941	roll 079, frame 322
1954	roll 229, frame 075
1954 (photograph revised 1968)	roll 079, frame 319
1954 (photograph revised 1968 and 1974)	roll 079, frame 318

Columbia Bottoms Quad Map

1935 (photographed 1924)	roll 079, frame 364
1941 (published 1952)	roll 079, frame 363
1941 (published 1959)	roll 079, frame 361

Granite City Quad Map

1940 (photographed 1933)	roll 059, frame 216
1950 (photographed 1949)	roll 059, frame 214
1956	roll 059, frame 213
1954 (photographed 1952; published 1958)	roll 059, frame 212
1954 (photographed 1952; published 1966)	roll 059, frame 211

St. Charles Quad Map

1933 (photographed 1927)	roll 082, frame 178
1947 (photographed 1927; revised 1946)	roll 082, frame 177
1955 (revised 1946)	roll 082, frame 176
1960 (photographed 1952)	roll 082, frame 175
1969 (photographed 1952; revised 1968)	roll 082, frame 169
1975 (photographed 1968)	roll 229, frame 378
1986 (photographed 1974)	roll 229, frame 377

Creve Coeur Quad Map

1940 (photographed 1933)	roll 079, frame 385
1956 (photographed 1933; revised 1954)	roll 079, frame 386
1959 (photographed 1952)	roll 079, frame 383
1966 (photographed 1952; revised 1965)	roll 082, frame 175
1969 (photographed 1968)	roll 082, frame 169
1976 (photographed 1974)	roll 229, frame 378

Florissant Quad Map

1954 (photographed 1952)	roll 080, frame 053
1966 (photographed 1952; revised 1954)	roll 080, frame 052
1968 (photographed 1968)	roll 080, frame 051
1975 (photographed 1974)	roll 229, frame 134
1982 (photographed 1979)	roll 385, frame 041

Many documents were reviewed during the preparation of this report. Those documents found to be most pertinent are listed in Appendix A.15.

3.0 SUMMARY OF POTENTIAL IMPACTS BY ROADS

3.1 SUMMARY OF RESULTS OF HISTORICAL TESTING

Testing has identified impacted material adjoining several suspected haul roads. This testing has also found evidence of impacts believed to be associated with erosion of the SLAPS and flooding of Coldwater Creek and also with wind and storm water erosion. Based on the results of all scanning information reports and analytical testing reviewed, impacted materials have been found under or adjoining the pavements of:

- McDonnell Boulevard. The possible cause of these impacts could be wind erosion from the adjoining SLAPS property or flooding of Coldwater Creek.

- Eva Avenue. The possible cause of these impacts could be haulage from the SLAPS to the HISS in 1966 and 1967. Eva Avenue is on the most direct route between the SLAPS and the HISS. A railroad lead track also crosses Eva Avenue. A lead track is an industrial spur that services multiple properties. This lead track would have been used for rail transport of residue from the HISS. Eva Avenue is also within the floodplain of Coldwater Creek; however this area would be a backwater, and flood related impacts to this area would be unlikely.

- Frost Avenue. The possible cause of these impacts could be haulage from the SLAPS to the HISS in 1966 and 1967. Use of Frost Avenue would have been a necessary if Eva Avenue were used.

- Hazelwood Avenue. The possible cause of these impacts could be haulage from the SLAPS to the HISS in 1966 and 1967. Hazelwood Avenue would likely have been used for haulage activities since it is the road allowing easiest access to the HISS. Other routes which avoid using Hazelwood Avenue are possible, but these routes are longer and offer no apparent advantage.

- Pershall Road. The possible cause of these impacts could be from flooding of Coldwater Creek, or haulage from the SLAPS to the HISS in 1966 and 1967.

- Latty Avenue. The possible cause of these impacts could be flooding of Coldwater Creek or haulage from the SLAPS to the HISS in 1966 and 1967. Latty Avenue must have been used for all haulage activity to and from the HISS, since it is the only road allowing access to the HISS.

- Banshee Road. The possible cause of these impacts could be wind erosion from the adjoining the SLAPS property or haulage of fill material to the SLAPS from the airport in the 1950s and 1973.

The results of this study are summarized in the following tables (Tables 3-1 through 3-5). The findings are categorized by the potential for direct impacts beneath the various pavement surfaces. These findings and the appendices to this report that detail the information used to reach these conclusions and results are summarized in Table 3-5. The sources of possible direct impacts by road are summarized in Table 3-6.

Table 3-1 identifies the roads potentially impacted by residue hauling activities between the SLAPS and the HISS. The type of pavement existing on each road used for hauling residues is evaluated to determine the probability that material under the existing pavement could have been impacted.

Table 3-1 Possible Impacts from Haulage SLAPS and the HISS 1966/67

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
			WIDENED OR PAVED	POSSIBLE IMPACT
STREET NAME	PAVED	USED	1966 TO 1973	
Airport Road	Yes PCC	Possible	40 feet PCC 1966	Possible
Banshee Road	Yes PCC/AC	No	8 feet PS	No
Dunn Road	Yes PCC	No	PS	No
Eva Avenue	1974 AC	Yes	No	Yes
Frost Avenue	1972 AC	Yes	8 feet AC	Yes
Hazelwood Avenue	Yes AC	Yes	No	No
I-170	1980 PCC	No	24 feet PS 1972	No
I-270	1962 PCC	No	No	No
Latty Avenue	>1965 AC	Yes	No	Yes
Lindbergh Boulevard	Yes PCC	Yes	40 feet AC	Yes
McDonnell Boulevard	Yes AC	Yes	8 feet AC 1974	Yes
North Hanley Road/Graham Road	Yes AC/PCC	Possible	48 feet PCC, PS 1972	Possible
Nyflot Avenue	Yes AC	No	28 feet AC 1974	No
Pershall Road	1962 PCC	Yes	PS	Yes
Polson Road	>1954 AC	No	No	No
Seeger Industrial Road	1971 PCC	No	No	No
		Shadowing added for emphasis	PS = Paved shoulders added.	Shadowing added for emphasis

- Column 1 lists roads within SLAPS Road Study Area.
- Column 2 lists the type of pavement in existence from 1966 to 1967, and if known the date pavement was constructed.
- Column 3 lists whether the road was likely to have been used for hauling residues from 1966 to 1967.
  - "Yes" means that residue hauling must have occurred on that road. It had to have been used.
  - "Probable" means that the judgment of this report is that residue hauling occurred on that road.
  - "Possible" means that the judgment of this report is that residue hauling on that road cannot be ruled out.
  - "No" means that the judgment of this report is that residue hauling on that road was either impossible or so improbable that it can be ruled out.
  - Column 4 lists whether the pavement was widened during or after the transport of residues from the SLAPS to the HISS, and the date that pavement was constructed. PS stands for "Paved Shoulders" and means that aggregate shoulders were replaced with pavement.
- Column 5 lists whether there was an impact to the material under the pavement constructed since 1966. Shadowing added for emphasis
  - "Yes" means that residue hauling is believed to have occurred on that road and that testing indicated that impacts did occur along that route.
  - "Likely" means that residue hauling is believed to have occurred on that road but that no testing has confirmed that belief.
  - "Possible" means that while it is not believed that hauling of residues occurred on that road, such hauling cannot be ruled out.
  - "No" means that no residue hauling is believed to have occurred on that road or that that road did not exist in this time period.

Table 3-2 identifies the roads potentially impacted by residue hauling activities between the HISS and the West Lake Landfill. The type of pavement existing on each road used for hauling residues is evaluated to determine the probability that material under the existing pavement could have been impacted.

Table 3-2 Possible Impacts from Haulage HISS and West Lake Landfill 1973

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
STREET NAME	HISS TO LANDFILL 1974			
	PAVED	USED	1973 TO PRESENT	POSSIBLE IMPACT
			WIDENED	
Airport Road	Yes PCC	No	8 feet PCC 1983	No
Banshee Road	Yes AC/PCC	No	PS	No
Dunn Road	Yes PCC	No	PS	No
Eva Avenue	Yes AC	Possible	2–4 feet AC	Possible
Frost Avenue	Yes AC	Possible	4-8 feet AC	Possible
Hazelwood Avenue	Yes AC	Probable	1-2 feet AC	Possible
I-170	Yes PCC	No	24 feet PCC 1983	No
I-270	Yes PCC	No	PS	No
Latty Avenue	Yes AC	Yes	8 feet PCC	Possible
Lindbergh Boulevard	Yes PCC	Possible	24 feet PCC 1978	Possible
McDonnell Boulevard	Yes AC	Possible	24 feet AC 1978	Possible
North Hanley Road/Graham Road	Yes AC/PCC	No	No	No
Nyflot Avenue	Yes AC	Possible	No	No
Pershall Road	Yes PCC	Possible	PS	Possible
Polson Road	Yes AC	No	No	No
Seeger Industrial Road	Yes AC	No	No	No

- Column 1 lists roads within the SLAPS road study area.
- Column 2 lists the existence of pavement in 1973.
- Column 3 lists whether the road was likely to have been used for hauling residues in 1973.
  - "Yes" means that residue hauling must have occurred on that road. It had to have been used.
  - "Probable" means that the judgment of this report is that residue hauling occurred on that road.
  - "Possible" means that judgment of this report is that residue hauling on that road cannot be ruled out.
  - "No" means that the judgment of this report is that residue hauling on that road was either impossible or so improbable that it can be ruled out.
- Column 4 lists whether the pavement was widened during or after the transport of residues from the HISS to the West Lake Landfill.
- Column 5 lists whether there was an impact to the material under the pavement constructed since 1973. "Possible" means that impacts could have occurred along that route; however, all routes have been gamma tested, and no evidence of impacts has been found except along routes also used in earlier hauling activities.
  - "Possible" means that residue hauling is believed to have occurred on that road.
  - "No" means that no residue hauling is believed to have occurred on that road or that that road did not exist in this time period.

Table 3-3 lists those roadways that are in locations where they might possibly be impacted by the movement of residues by wind, stormwater runoff or floodwaters.

Table 3-3 Potential Wind, Stormwater or Floodwater Impacts

COLUMN 1	COLUMN 2	COLUMN 3
STREET NAME	**COLDWATER CREEK FLOODPLAIN**	**ADJOIN SLAPS/HISS WIND/STORM**
Airport Road	No	No
Banshee Road	Yes	Yes
Dunn Road	Yes	No
Eva Avenue	Yes	No
Frost Avenue	Yes	No
Hazelwood Avenue	No	No
I-170	No	No
I-270	Yes	No
Latty Avenue	Yes	Yes
Lindbergh Boulevard	No	No
McDonnell Boulevard	Yes	Yes
North Hanley Road/Graham Road	No	No
Pershall Road	Yes	No
Polson Road	No	No
Seeger Industrial Road	Yes, minor	No

- Column 1 lists roads within the SLAPS Road Study Area.
- Column 2 lists whether part of the road pavement is within the floodplain of Coldwater Creek. "Yes" means that portions of the pavement are within the floodplain.
- Column 3 lists whether that road lies adjacent to the SLAPS or the HISS and is potentially impacted by windborne or stormwater runoff borne residue. "Yes" means that portions of the pavement could be over impacted material.

Table 3-4 summarizes the results of known historical testing and indicates when and what type of testing was done, the results of that testing and any activities reportedly undertaken to respond to the test results.

Table 3-4 Results of Testing

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
STREET NAME	TESTED GAMMA	IMPACT FOUND GAMMA	TESTED LAB	IMPACT FOUND LAB	CLEANED UP
Airport Road	1985/1991	No/No	No	N/A	No
Banshee Road	1991	No	1984-1989	Yes	No
Dunn Road	No	N/A	No	N/A	No
Eva Avenue	1985/1991	No/No	1984-1989	Yes	Partial
Frost Avenue	1985/1991	No/No	1984-1989	Yes	Partial
Hazelwood Avenue	1985/1991	Yes/No	1984-1989	Yes	Partial
I-170	No	N/A	No	N/A	No
I-270	No	N/A	1984-1989	Yes	No
Latty Avenue	1991	No	1984-1989	Yes	Yes
Lindbergh Boulevard	1985	No	No	N/A	No
McDonnell Boulevard	1985/1991	Yes/No	1984-1989	Yes	Partial
North Hanley Road/Graham Road	1985/1991	No/No	No	N/A	No
Nyflot Avenue	No	N/A	No	N/A	No
Pershall Road	1985/1991	Yes/No	1984-1989	Yes	No
Polson Road	No	N/A	No	N/A	No
Seeger Industrial Road	No	N/A	No	N/A	No

- Column 1 lists roads within SLAPS Road Study Area.
- Column 2 lists whether the pavement was tested by gamma radiation methods and the year that those test results were reported.
- Column 3 lists whether impacts were detected by the gamma testing methods.
- Column 4 lists whether the roadway was tested by field sample collection and laboratory testing methods near, under, or in the pavement, by listing the year that those test results were reported.
- Column 5 lists whether the laboratory testing methods detected impacts.
- Column 6 lists whether the test results lead to actions near the roadways. "Yes" means that both materials under the pavement and on the shoulders have had past action taken. "Possible" means that the shoulders have had past action taken.

Shadowing added for emphasis.

Table 3-5 expands on the description of the road segments and summarizes the results of this report.

Table 3-5 Summary of Findings

ROAD DESCRIPTION	CONDITION OF MATERIAL UNDER PAVEMENT
I-170 from Airport Road to I-270	Not impacted, except in some limited areas
I-270 from Lindbergh Boulevard (67) to Graham Road	A mix of impacted and non-impacted areas
Lindbergh Boulevard (67) from McDonnell Boulevard to I-270	A mix of impacted and non-impacted areas
McDonnell Boulevard from Airport Road to 67	A mix of impacted and non-impacted areas
Eva Avenue	All impacted
Frost Avenue	All impacted
Latty Avenue	All impacted, but action taken after testing
Hazelwood Avenue	Not impacted except in some limited areas
Pershall Road from 67 to Graham Road	A mix of impacted and non-impacted areas
Dunn Road from 67 to Graham Road	A mix of impacted and non-impacted areas
Airport Road from McDonnell Boulevard to I-170	A mix of impacted and non-impacted areas.
North Hanley Road from 1-270 to Airport Road	A mix of impacted and non-impacted areas.
Banshee Road from McDonnell Boulevard to Coldwater Creek	All impacted
Nyflot Avenue from Graham Road to Hazelwood Avenue	Not impacted
Seeger Industrial Drive	Not impacted except in some limited areas
Polson Road	Not impacted
Graham Road	A mix of impacted and non-impacted areas

Table 3-6 summarizes the possible cause of impacts under or near roads pavements in the SLAPS Roads Study Area.

Table 3-6 Cause of Impacts

COLUMN 1	COLUMN 2
STREET NAME	**COMMENTS**
	(IMPACTS CAUSED BY)
Airport Road	Possible hauling road
Banshee Road	Probably used to bring fill to the SLAPS and adjoins the SLAPS; possibly impacted by wind erosion from the SLAPS
Dunn Road	Coldwater Creek floodplain and probable hauling road
Eva Avenue	Coldwater Creek and certain hauling road
Frost Avenue	Coldwater Creek and certain hauling road
Hazelwood Avenue	Certain haul road but center 18 feet of pavement would have protected material underneath from direct impacts.
I-170	Constructed crossing former hauling roads but most not impacted.
I-270	Coldwater Creek and possible hauling road
Latty Avenue	Action taken
Lindbergh Boulevard	Certain hauling road and greatly widened, with much new pavement.
McDonnell Boulevard	Coldwater Creek, floodplain, adjoins the SLAPS, and certain hauling road
Nyflot Avenue	Not impacted
North Hanley Road/Graham Road	Graham Road possible hauling road; North Hanley not impacted
Pershall Road	Coldwater Creek floodplain and certain hauling road
Polson Road	Not impacted
Seeger Industrial Road	Partially in Coldwater Creek flood plain.

- Column 1 lists roads within SLAPS Road Study Area.
- Column 2 lists the possible source of Impacts and selected general information

Shadowing added for emphasis.

These findings and conclusions are perhaps best viewed by review of Exhibit A, which shows the entire project area at a 1-inch-equal-to-600-feet scale and shows the status of each roadway.

3.2 TYPICAL RIGHT-OF-WAY WIDTHS

Table 3-7 lists the typical current ROW widths for each road investigated in this study. Current ROW widths are also shown on the attached figures.

Table 3-7 Typical Right-of-way Widths

STREET OR ROAD	TYPICAL WIDTH OF ROW
Eva Avenue	40 feet
Hazelwood Avenue	80 feet south of Latty Avenue 85 feet north of Latty Avenue
Latty Avenue	45 or 50 feet
Frost Avenue	40, 45, or 50 feet
I-170	As marked in the field; typically 250 to 500 feet
I-270	As marked in the field; typically 350 to 600 feet
Lindbergh Boulevard	Varies from 120 to 300 feet
North Hanley Road	80 feet
Graham Road	40 feet
Airport Road	82 feet
Banshee Road	60 feet
Pershall and Dunn roads	Now part of I-270
Polson Road	20 and 18 feet
Seeger Industrial Drive	50 feet
Nyflot Road	40 feet
McDonnell Boulevard	Varies; typically 150 feet

3.3 AREAS OF FILL

There is evidence of fill being placed in areas that may have been impacted in the following areas:

- Much of McDonnell Boulevard was raised by placing 3 to 4 foot of earth fill above the former Brown Road, probably to elevate the roadway above the floodplain of Coldwater Creek. Fill near Coldwater Creek is up to approximately 10 feet in thickness. At the intersection of Eva Avenue with McDonnell Boulevard, Eva Avenue was raised approximately 3 to 4 feet, this fill transitions back to match the existing ground over a distance of approximately 200 feet.
- I-170 was elevated to pass over many of the cross streets with as much as 25 feet of fill being placed.
- Portions of the intersection ramps of I-170 and I-270 and of Lindbergh Boulevard and I-270 were also elevated with fill ranging in thickness from 0 to 25 feet.

3.4 BRIDGES

This section discusses whether bridge abutments and approaches could be constructed over impacted material, rendering that material inaccessible. The locations of these bridges are shown on Exhibit A.

- McDonnell Boulevard over Coldwater Creek

A bridge existed in this location prior to 1946 (MoDOT construction plans available). A replacement bridge was constructed in 1952 (MoDOT construction plans available). McDonnell Boulevard was widened in 1974. (No construction plans were available for this work.)

This area was subjected to possible impacts from: wind erosion from the SLAPS residue storage, water erosion from the SLAPS in conjunction with Coldwater Creek flooding, the SLAPS to the HISS haulage activities in 1966 and 1967, rail lines likely used for the 1966 to 1973 transport of residue from the HISS to Colorado, and HISS to West Lake Landfill haulage activities in 1973.

At least some of these events occurred prior to the construction of the current bridge; therefore, it is possible that the material under this bridge's abutments could have been impacted. However, typical bridge abutment construction methods would result in the removal of material and its subsequent replacement with concrete or other structural materials a short time later, so while it is possible that materials under this bridge abutment have been impacted, the probability of such impact is low. Impacts from Coldwater Creek flooding while possible, would also have a low probability of impact.

- Pershall Road over Coldwater Creek

This bridge was constructed in 1962.

This area was subjected to possible impacts from water erosion from the SLAPS in conjunction with Coldwater Creek flooding, probably to the SLAPS to the HISS haulage activities 1966 and 1967, and possibly to the HISS to West Lake Landfill haulage activities in 1973.

At least some of these events occurred prior to the construction of the current bridge, therefore it is possible that the material under this bridge's abutments could have been impacted. However, typical bridge abutment construction methods would result in the removal of material and it's subsequent replacement with concrete or other structural materials a short time later, so while it is possible that materials under this bridge abutment have been impacted, the probability of such impact is low. Impacts from Coldwater Creek flooding while possible, would also have a low probability of impact.

- I-270 over Coldwater Creek

This bridge was constructed in 1962.

This area was subjected to possible impacts from water erosion from the SLAPS (Coldwater Creek flooding) and possibly to the SLAPS to the HISS haulage activities in 1966.

At least some of these events occurred prior to the construction of the current bridge, therefore it is possible that the material under this bridge's abutments could have been impacted. However, typical bridge abutment construction methods would result in the removal of material and it's subsequent replacement with concrete or other structural materials a short time later, so while it is possible that materials under this bridge abutment have been impacted, the probability of such

impact is low. Impacts from Coldwater Creek flooding while possible, would also have a low probability of impact.

- Dunn Road over Coldwater Creek

A bridge was constructed in the 1930s (1930 bridge). This bridge was demolished and the road realigned shortly before 1990. A new bridge was constructed (1990 bridge). Fresh earthwork is visible in the 1990 photograph contained in the EPA Region VII study *Aerial Photographic Analysis of the St. Louis Airport Study Area* dated August 1992.

This area was subjected to possible impacts from water erosion from the SLAPS (Coldwater Creek flooding).

At least some of these events occurred prior to the construction of the current bridge, therefore it is possible that the material under this bridge's abutments could have been impacted. However, typical bridge abutment construction methods would result in the removal of material and it's subsequent replacement with concrete or other structural materials a short time later, so while it is possible that materials under this bridge abutment have been impacted, the probability of such impact is low. Impacts from Coldwater Creek flooding while possible, would also have a low probability of impact.

If abutments or approaches to the 1930 bridge remain, they would have protected the material under them from direct impact.

- Banshee Road over Coldwater Creek

A bridge existed in this location prior to 1941. By 1953, Coldwater Creek south of this bridge had been enclosed.

This area was subjected to possible impacts from wind erosion from the SLAPS residue storage.

These impacts occurred after the construction of the current bridge; therefore the material under this bridge should not be impacted.

- Frost Avenue over East Branch of Coldwater Creek

A bridge existed in this location prior to 1946 and is believed to be the same bridge now in existence.

This area was subjected to possible impact from water erosion from the SLAPS (Coldwater Creek flooding), the SLAPS to the HISS haulage activities 1966 and 1967, and rail lines likely used for the 1966 to 1973 transport of residue from the HISS to Colorado, and the HISS to West Lake Landfill haulage activities 1973.

These impacts occurred after the construction of the current bridge; therefore, the material under this bridge should not be impacted.

- Graham Road over East Branch of Coldwater Creek

A bridge existed in this location prior to 1946 and is believed to be the same bridge now in existence.

This area was subjected to possible impacts from water erosion from the SLAPS (Coldwater Creek flooding) and the SLAPS to the HISS haulage activities in 1966 and 1967.

The Coldwater Creek flooding in this area would be an area of ineffective flow. Ineffective flow means that while water would flood this area, it would not convey any significant portion of the flood; it would be a backwater. It is unlikely that this flooding would have resulted in impact to materials. These impacts occurred after the construction of the current bridge; therefore, the material under this bridge should not be impacted.

- I-170 Overpass over Airport Road

This overpass was constructed in 1980.

This area was subjected to possible impact from the SLAPS to the HISS haulage activities in 1966 and 1967 on Airport Road. The overpass is also over obliterated Graham Road. The SLAPS to the HISS haulage activities on Airport Road and this section of Graham Road cannot be ruled out.

The impact from possible haulage activities occurred prior to the construction of this dual bridge overpass; therefore the material under these overpasses could be impacted.

- I-170 Overpass over Norfolk Southern Rail lines and East Branch of Coldwater Creek

This overpass was constructed in 1980.

This area was subjected to no known mechanisms for impact other than the possible flooding from Coldwater Creek. This flooding is in an area of ineffective flow and would not have impacted materials in this area. Therefore, the material under these overpasses should not be impacted.

- I-170 Overpass over Frost Avenue

This overpass was constructed in 1980.

This area was subjected to possible impact from the SLAPS to the HISS haulage activities in 1966 and 1967 on Frost Avenue. The SLAPS to the HISS haulage activities on Frost Avenue and this section of Frost Avenue have been confirmed by testing.

The impact from possible haulage activities occurred prior to the construction of this dual bridge overpass; therefore, the material under these overpasses could be impacted.

- I-170 Overpass over Nyflot Avenue

This dual bridge overpass was constructed in 1980.

This area was subjected to no known mechanisms for impacts; therefore, the material under these overpasses should not be impacted.

3.5 ADDITIONAL INFORMATION

A more detailed description of the source documents reviewed and the conclusions drawn from that review is included in the appendices. This information is organized into segments based on individual roads. Each appendix contains figures at a 1-inch-equal-to-80 foot-scale, showing which pavements could require further investigation and which would not require further investigation. Exhibit B provides a key to the location of each figure.

4.0 REFERENCES

1. *Results of Mobile Gamma Scanning Activities in St. Louis, Missouri,* by Oak Ridge National Laboratory and Martin Marietta Energy Systems, Inc. for the U. S. Department of Energy, June 1991. ORNL/RASA-90/7.

2. *St. Louis Airport/Hazelwood Interim Storage/Futura Coating Company St. Louis, St. Louis County, Missouri,* CERCLA No. MOD980633176, U. S. Department of Health and Human Services Public Health Service Agency for Toxic Substances and Disease Registry, May 10, 1991.

3. *Results of the Mobile Gamma Scanning Activities in Berkeley, Bridgeton, and Hazelwood, Missouri,* by Oak Ridge National Laboratory, operated by Martin Marietta Energy Systems, Inc. for the U. S. Department of Energy, June 1985, ORNL/RASA-85/7.

4. *Radiological Characterization Report for FUSRAP Properties in the St. Louis, Missouri, Area,* by Bechtel National, Inc., August 1990, DOE/OR/20722-203.

5. *Results of Mobile Gamma Scanning Activities in St. Louis, Missouri,* by Oak Ridge National Laboratory and Martin Marietta Energy Systems, Inc. for the U. S. Department of Energy, June 1991. ORNL/RASA-90/7.

6. *History of Material Storage at the St. Louis Airport Storage Site.*

7. In 1984 the U.S. Department of Energy (DOE) issued a report titled *Post-remedial Action Report for the Hazelwood Site.*

8. According to an August 15, 1967 memo titled *Historical Review of the Mallinckrodt Airport Cake.*

9. U.S. Atomic Energy Commission, entitled *Hamm Drayage Co. 1957 Hauling Contract, Subcontract No. 25033M* and dated November 28, 1956.

10. *St. Louis Airport Residue*, unpublished government document. Miller, 1965.

11. *Committee Report on Disposition of St. Louis Airport Storage Site*, United States of America atomic Energy Commission. November 5, 1965.

12. *Results of the Radiation Measurement Taken of Transportation Routes (LM004) in Hazelwood, Missouri.* Oak Ridge National Laboratory. December 1986.

13. *Aerial Photographic Analysis of the St. Louis Airport Study Area, Hazelwood, Missouri.* U.S. Environmental Protection Agency, 1992.

APPENDICES

A.1 through A.15

A.1 Pavement Evaluation of McDonnell Boulevard

Background Information

Some reference stations along McDonnell Boulevard are as follows:

- The intersection of McDonnell Boulevard and Lindbergh Boulevard is McDonnell Boulevard Station 0+00 and Lindbergh Boulevard Station 163+73.
- The intersection of McDonnell Boulevard and Coldwater Creek is McDonnell Boulevard Station 30+05.
- Approximate station of Airport Road and McDonnell Boulevard is McDonnell Boulevard Station 99+00.

Evaluation of Aerial Photographs and Construction History Information

In the July 29, 1941, aerial photograph contained in the August 1992 EPA Region VII study, there is a small road in the approximate alignment of McDonnell Boulevard north of the Norfolk Southern railroad tracks to Coldwater Creek. The portion of the road shown does not appear to have a hard-surface pavement. There is a small bridge west of Coldwater Creek. The road has been surfaced to two lanes with an oil-and-chip surface.

Construction plans from 1943 show Brown Road from Highway 66 (Lindbergh Boulevard) Station 0+00 to Station 30+05 east (approximately Coldwater Creek) to be constructed of 7 inches of aggregate with 2 inches of penetration macadam and a seal coat. This is a high-quality oil-and-chip road surface. It is not believed that this surface would be considered durable or water-resistant enough to protect material underneath from direct impacts. This information is also shown on MoDOT pavement history drawing "St. Louis 096 Sheet 25 of 31."

Construction plans from MoDOT (Federal Project MO S-1207 [1]) from 1952 show that a new four-lane highway was constructed. From Station 0+00 to Station 26+00, the 1943 surface was 40 feet and was resurfaced with an AC overlay. From Station 26+00 to Station 72+00, new 40-foot-wide AC pavement was constructed. From Station 72+00 to Station 87+21.5, the surface was 40 foot and was resurfaced with an AC overlay. From Station 87+21.5 to Station 109+12.25, the typical section of new construction was 44 feet of 8-inch PCC pavement with 10-foot earth shoulders. The reconstructed sections of the road did not always follow the exact alignment of former Brown Road. This information was taken from MoDOT pavement history drawing "St. Louis 096 Sheet 25 of 31."

In the September 11, 1953, aerial photograph contained in the August 1992 EPA Region VII study, a new hard-surface, four-lane, paved road had been constructed. This road is known as State Route STT or McDonnell Boulevard.

The 1954 USGS quad map based on a 1952 aerial photograph shows McDonnell Boulevard as a heavy-duty paved road from Lindbergh Boulevard to the old Eva Avenue/Brown Road railroad crossing where the old crossing remains in place. The heavy-duty pavement continues on the south side of the railroad.

In the September 11, 1958, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1953 photograph.

In the October 10, 1965, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1958 photograph.

The 1968 USGS quad map shows McDonnell Boulevard as a heavy-duty paved road from Lindbergh Boulevard to Airport Road. The railroad crossing has been reconstructed since the 1954 mapping.

In the May 4, 1971, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1965 photograph.

In the May 6, 1974, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1971 photograph.

The 1974 USGS quad map shows McDonnell Boulevard as a heavy-duty paved road from Lindbergh Boulevard to Airport Road.

In 1974 the road from Station 6+00 to Station 65+00 was widened to 48 feet and received a new AC overlay. From Station 65+00 to Station 87+25, the road was widened to 44 feet with a 10-foot left turn lane. This information was taken from MoDOT pavement history drawing "St. Louis 096 Sheet 25 of 31."

In 1978 PCC widening occurred on the left and right and two 24-foot AC lanes were resurfaced from Station 0+00 to Station 8+65. This information was taken from MoDOT pavement history drawing "St. Louis 096 Sheet 25 of 31."

In the December 22, 1980, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1974 photograph.

In the May 1, 1984, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1980 photograph.

Anomalies were detected in the December 14, 1984, scan by EPA. In the May 1, 1985, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1984 photograph.

In the April 8, 1990, aerial photograph contained in the August 1992 EPA Region VII study, the McDonnell Boulevard pavement does not appear to have changed in alignment, width, or pavement type since the 1985 photograph.

In 1988 a 48-foot-wide pavement was resurfaced with AC from Station 0+00 to Station 65+00. From Station 65+00 to Station 109+06, a 44-foot-wide pavement overlay and a new turn lane were constructed. This information was taken from MoDOT pavement history drawing "St. Louis 096 Sheet 25 of 31."

On an April 4, 2002, site visit, it was apparent that the pavement had recently (within 1 year) been overlaid with a new AC surface.

Summary of Critical Facts

A 70-foot ROW for McDonnell Boulevard west of Coldwater Creek was created some time before 1950. An 80-foot ROW for McDonnell Boulevard east of Coldwater Creek was created some time before 1950.

In 1943 a four-lane, 40-foot-wide, oil-and-chip road existed to the west of Coldwater Creek. East of Coldwater Creek the road was a two-lane dirt or oil and clip aggregate road.

In 1952 part of the road was paved with 40-foot AC in a manner that would protect the materials beneath the road from Station 0+00 to Station 87+22. From Station 87+22 to the intersection with Airport Road, a 44-foot PCC pavement was constructed. The portion of McDonnell Boulevard adjoining Coldwater Creek and the SLAPS itself could have been impacted by storm water, floodwater, or windborne residue prior to the placement of this pavement.

In 1974 the road was rehabilitated and widened and the new pavement placed over impacted material.

Three additional AC resurfacings have taken place since 1952: one in 1974, one in 1988, and one in 2002. Paved shoulders have also been constructed.

Final Conclusions

McDonnell Boulevard from Airport Road to Lindbergh Boulevard

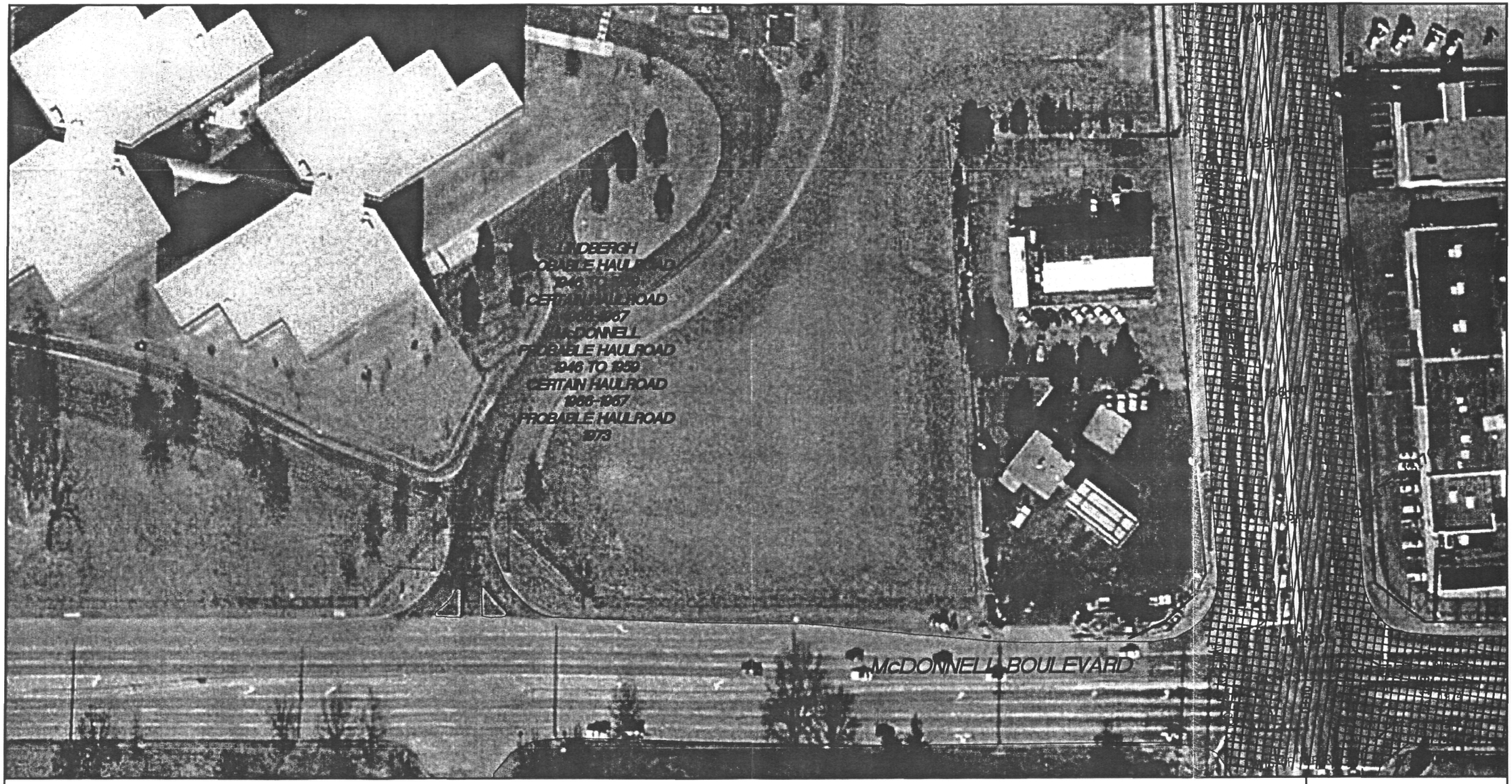
That portion of McDonnell Boulevard adjoining the SLAPS was not impermeablely paved prior to the start of activities at the site in 1946. All material under the existing pavement could have been impacted.

That portion of McDonnell Boulevard within the floodplain of Coldwater Creek was not impermeablely paved prior to the start of activities at the SLAPS in 1946. All material under the existing pavement could have been impacted.

The SLAPS to the HISS hauling activities. From 1966 to 1967 McDonnell Boulevard was hard-surfaced and impermeablely paved, and this pavement would have protected the material under it; however, McDonnell Boulevard has been widened, and paved shoulders have been constructed since that time. It is certain that hauling occurred from the SLAPS to the HISS using Eva Avenue. It is very likely that hauling occurred from the SLAPS to Lindbergh Boulevard. It is possible, but not likely, that hauling occurred on McDonnell Boulevard from Eva Avenue to Airport Road. Any pavement widening that has since occurred or any construction of paved shoulders could be over impacted material.

The HISS to West Lake Landfill site. In 1973 McDonnell Boulevard was hard-surfaced and impermeablely paved, and this pavement would have protected the material under it; however, McDonnell Boulevard has been widened, and new paved shoulders have been constructed since that time. It is possible that hauling occurred on McDonnell Boulevard from Eva Avenue to Lindbergh Boulevard. The pavement at the intersection with Lindbergh Boulevard was widened in 1978. Any pavement widening that has since occurred or any construction of paved shoulders could be over impacted material.

MATCH LINE LINDBERGH 3



MATCH LINE McDONNELL 2

LEGEND:

- RIGHT-OF-WAY LINE
- APPROXIMATE EDGE OF PAVEMENT (1965)
- APPROXIMATE EDGE OF PAVEMENT (1997)
- FURTHER INVESTIGATION REQUIRED
- SHOULD NOT BE IMPACTED
- FORMER ROAD PAVEMENT

BACKGROUND PHOTO FROM 1997.

● FIELD SAMPLE WITH SOR>1

○ FIELD SAMPLE WITH SOR<1

LINDBERGH
1934 – 40' 8" PCC PAVEMENT CONSTRUCTED – 92+80 to 213+00 (LABEDED 1934)
1967 – WIDENED TO 36' EACH WAY, CONSTRUCT MEDIAN, AC RESURFACE – 144+00 to 211+25 (LABELED 1967)
1978 – 2 12' PCC LANE WIDENING RT & LT, AC RESURFACE – 144+00 TO 211+00 (LABELED 1978)
1991 – AC RESURFACE – 144+00 to 211+25

McDONNELL
1943 – 40' 7" STONE AND SEAL COAT PAVEMENT CONSTRUCTED – 0+00 TO 30+45 (LABLED 1943)
1952 – AC RESURFACE – 0+00 TO 26+00
1974 – WIDENED TO 48' AND AC RESURFACE 0+00 to 65+00 (LABELED 1974)
1978 – PCC WIDENING LT & RT AND AC RESURFACE 0+00 TO 8+65 (LABELED 1978)
1988 – AC RESURFACE

0 40 80 160
SCALE: 1" = 80'

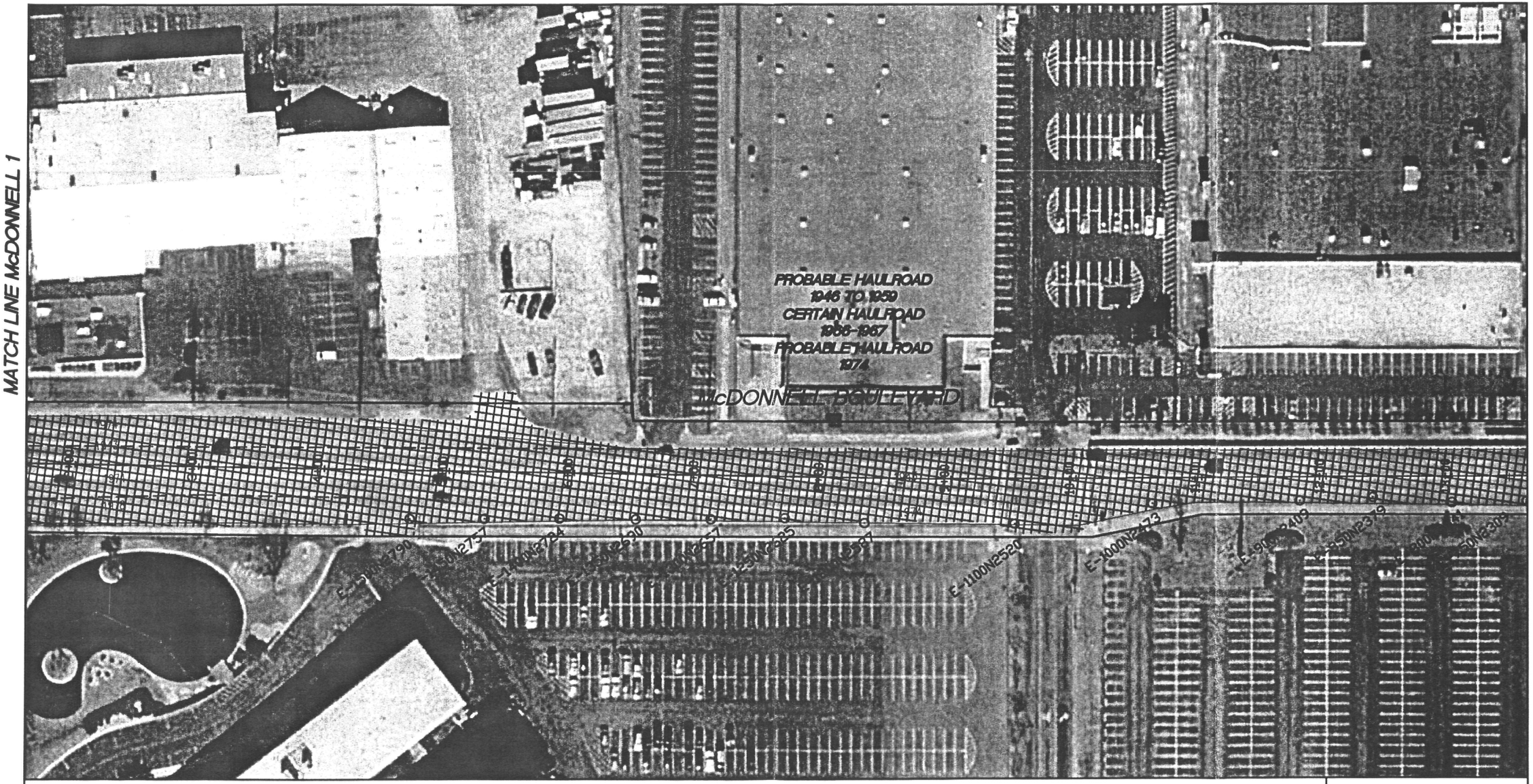
FUSRAP

ST. LOUIS NORTH COUNTY SITES
NORTH CO. HAUL ROAD ANALYSIS
ST. LOUIS, MO.

DRAWN BY:	REV. NO./DATE:
J. LOUGH	FINAL/01-07-05

FIGURE McDONNELL 1.

MATCH LINE McDONNELL 1



MATCH LINE McDONNELL 3

LEGEND:

- RIGHT-OF-WAY LINE
- APPROXIMATE EDGE OF PAVEMENT (1965)
- APPROXIMATE EDGE OF PAVEMENT (1997)
- FURTHER INVESTIGATION REQUIRED
- SHOULD NOT BE IMPACTED
- FORMER ROAD PAVEMENT

BACKGROUND PHOTO FROM 1997.

- FIELD SAMPLE WITH SOR>1
- FIELD SAMPLE WITH SOR<1

McDONNELL

1943 - 40' 7" STONE AND SEAL COAT PAVEMENT CONSTRUCTED - 0+00 TO 30+45 (LABELED 1943)
1952 - AC RESURFACE - 0+00 TO 26+00
1974 - WIDENED TO 48' AND AC RESURFACE 0+00 to 65+00 (LABELED 1974)
1978 - PCC WIDENING LT & RT AND AC RESURFACE 0+00 TO 8+65
1989 - AC RESURFACE - 0+00 to 65+00
2002 - AC RESURFACE

0 40 80 160

SCALE: 1" = 80'

FUSRAP

ST. LOUIS NORTH COUNTY SITES
NORTH CO. HAUL ROAD ANALYSIS
ST. LOUIS, MO.

DRAWN BY: J. LOUGH

REV. NO./DATE: FINAL/01-07-05

FIGURE McDONNELL 2.